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THE PRAIRIE HOME ORCHARD

by

W. R. LESLIE

CANADA DEPARTMENT OF AGRICULTURE

Price, 25 cents

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PRAIRIE HOME ORCHARD

by

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EXPERIMENTAL FARMS SERVICE
CANADA DEPARTMENT OF AGRICULTURE

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THE PRAIRIE HOME ORCHARD

The Canadian prairies were blessed with a considerable range of tree fruits before white men appeared upon the scene. These fruits were found mostly along watercourses, in ravines, among sand hills, or in the lee of poplar groves which dotted the country as tree islands. Found generally across the three Prairie Provinces were pin cherries, choke cherries, saskatoons or serviceberries, pembinas or highbush cranberries, buffaloberries, hawthorns, and hazels. In Manitoba, American plum and Canada plum formed extensive thickets. Sand cherries were encountered as far north as Hudson Bay Junction in Saskatchewan. Sweetberry honeysuckles were restricted chiefly to the acid soil areas north of the prairie country. Pioneer settlers enjoyed these tree fruits and used them extensively to augment the highly prized harvest of wild small fruits—strawberries, raspberries, gooseberries, clove, red, black and white currants.

In recent years very many home-makers across the Northern Great Plains have become increasingly active in establishing family orchards. As the growing of tree fruits—apples, pears, plums, cherries, apricots, and walnuts—is a new venture to many, this bulletin is written to carry suggestions on the establishment and care of the home orchard on the prairies.

Wind

It is impractical to attempt tree fruit growing on the Canadian prairies unless shelter is provided against winds. Shelter may come from natural hills, native woodlands, or from rows of planted trees. A hill is considered twice as effective as a deciduous tree shelter. Belts of evergreen conifers are intermediate in effect. As most unplanted farms in the prairie region are almost treeless and relatively level, discussion here will relate to such conditions.

Formerly the term *windbreak* was used for a planting of one or more rows of trees while *shelterbelt* referred to a planting of five or more rows, or to that number of rows sufficient to impart the impression of a grove. Nowadays the two terms are commonly employed indiscriminately.

An efficient windbreak performs the following functions:

1. It protects the soil and tissues of fruit trees against drying winds. The benefit extends throughout the year, protecting against the prevailing westerly winds of summer and autumn, the penetrating cold north winds of winter, and the parching hot south winds of summer.

2. It prevents undue drying out of the blossoms and thus extends the time that the stigmas remain prime for pollination.

3. It permits bees and other pollinating insects to work on the flowers in breezy weather. A wind blowing freely at 15 miles per hour restrains bee flight considerably. When winds reach a velocity of 25 miles per hour, the bees remain in their hive. This may mean little or no set of fruit.

4. It decreases the danger of fruit being blown from the spurs and twigs, and of mechanical injury to foliage and branches through lashing by the winds.

5. It attracts and supplies homes for insect-eating birds.

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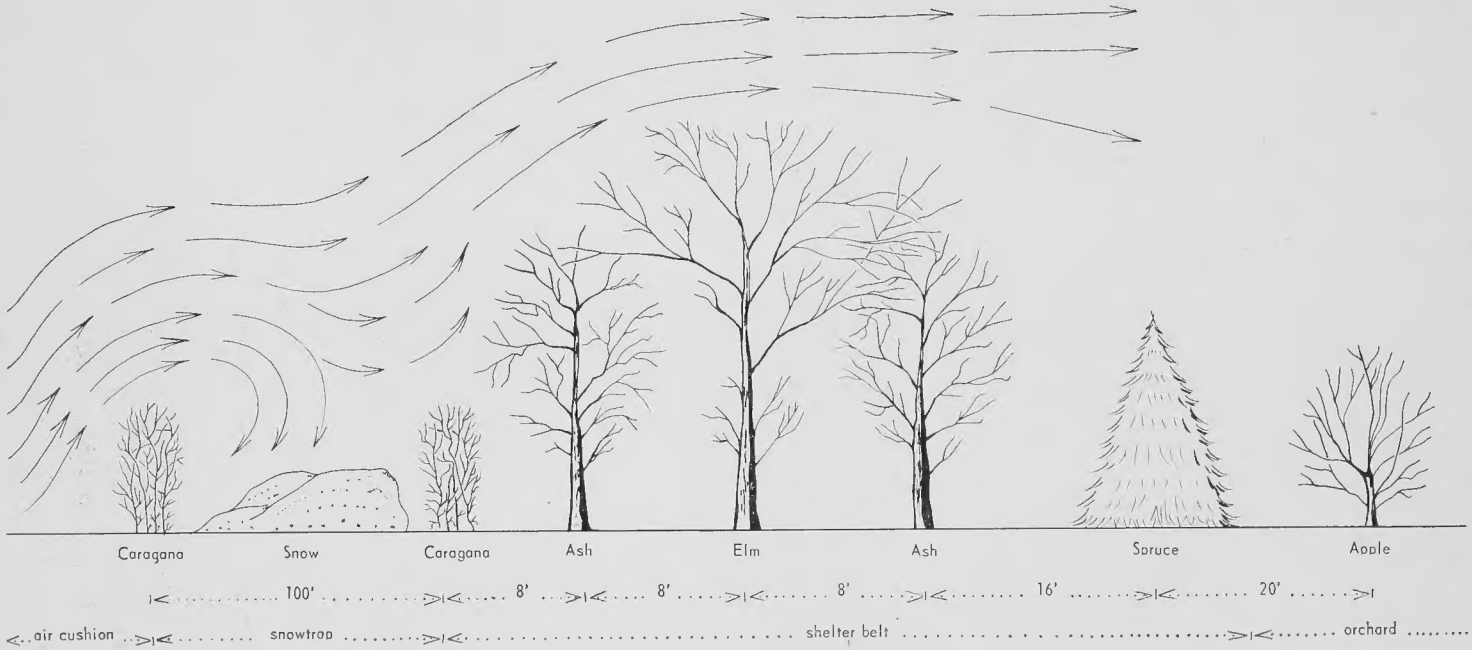

FIG. 1. A shelterbelt, showing the drifting snow settling on its windward side as a result of the snowtrap hedge planted about 100 feet distant.

6. It traps and holds drifting snow, and favors the deposit of an even blanket of snow in the sheltered orchard area. The accumulated snow not only supplies a protective covering to the roots and crowns of the fruit trees but also contributes moisture when spring thaws take place.

In contrast to the advantages derived from the presence of an orchard windbreak, the following disadvantages may result.

1. Temperatures in the sheltered portion may be lower at night and higher in mid-day. However, such differences usually are so small as to be of slight significance. The atmospheric calm that accompanies extremes of temperature is of much greater consequence because of its effect in reducing evaporation, and, in semi-arid regions, a goodly supply of moisture is the more critical consideration. Late spring and early autumn frosts usually occur on calm nights, and under such conditions shelter plays a rather minor role.

2. Windbreaks attract birds, and some species eat or damage fruit. This loss is usually offset by the destruction of injurious insects.

3. Trees in the windbreak may harbor plant diseases and thus endanger the fruit trees. This possibility is removed by selecting for the shelter trees that are not susceptible to fireblight, black knot, brown rot, and other diseases.

Plan of Windbreak

Satisfactory shelter may be provided by a windbreak of 5 rows on the north and west, 2 rows on the south, and 1 row on the east boundary of the orchard. If any side is to be unsheltered, it should be the east. A snowtrap may be planted on the north and west sides.

The snowtrap may be composed of a single hedge row. Common caragana, with seedlings set 12 inches apart and headed back to a height of 4 inches at the time of planting to induce dense low branching, is widely used. If there is a stretch of low-lying or moist land, caragana probably would fail, so sharpleaf or laurel willows set 2 feet apart should be used instead. Other subjects adapted to close hedge planting include saskatoon (serviceberry), choke cherry, Dahurian buckthorn, hawthorn, buffaloberry, and a wire fence clothed with native grape.

FIG. 2. Apricot trees in bloom at Morden. The spruce row is for permanent shelter. Native grapes clothe a wire fence, providing efficient low shelter.

The purpose of the snowtrap, as implied by the term, is to cause the deposit of drifting snows carried by the wind. The space between the one or two hedge rows and the outer rows of the main shelterbelt should be at least 60 feet and may be as much as 150 feet. The snowtrap area may be utilized to house the dugout reservoir and also a plantation of strawberries or cool-weather vegetables. The northern side of the main belt is favorable for bush fruits, particularly black currants. These enjoy cool moist conditions, and shade on their south exposure may help to delay flowering, thus avoiding frost injury to the blossoms.

The main belts on the north and west should have a dense outer row of medium low height with branches down to the ground, a second and fourth row of intermediate height, a tall third or central row, and a fifth row that is dense in habit and preferably evergreen. The first row may be caragana, buckthorn, choke cherry, saskatoon, nannyberry, buffaloberry, lilac or clove currant. The second and fourth rows may be green ash, Russian olive, Amur cherry, or acuteleaf willow. Boxelder (Manitoba maple) is used by many farmers; but has the disadvantage of intolerance to drought, a tendency to be insect-ridden, and the annoying weed trees that arise from its dispersed seeds. The middle or third row may be American elm, Siberian elm of the Manchurian strain, cottonwood, or hackberry. For the inside row there are three excellent hardy varieties of spruce—the Black Hills, the native white, and the Colorado.

FIG. 3. Colorado spruce as the inside row of a shelter. The hybrid peach trees tend to kill back severely even in the most favorable setting shown here. The exception is in mild winters when deep snows come in November and remain until March.

The belt on the south may be similar to rows 1 and 2, or 1 and 3, or 1 and 5. The east belt may be a single row of any adapted healthy tree.

The wisdom of using seedling fruits such as plum, crabapple, pear, or apricot in the shelterbelt is questionable because of possible outbreaks of orchard diseases and insects thereon. With close planting in the windbreak, control of disease by spraying would be difficult.

Spacing varies with the climate and location. In dry climates more space is necessary between the rows. However, close planting in the row itself is indicated. The hedgerows are to provide thick shelter and wide spacing results in a grove rather than in a shelter hedge. For Manitoba, the spacing suggested is: rows 2, 3 and 4; 6 to 8 feet apart with trees 4 feet apart in the row. Row 5, of spruce, should be 16 feet from its neighboring row with trees 4 to 6 feet apart. Row 1 should have its trees or shrubs 1 to 4 feet apart according to the variety used. In drier areas it may be best to have all the rows as much as 16 feet apart. Cultivation should be sufficient to prevent invasion by grass and weeds.

Performance of the Windbreak

The theory of a windbreak is that most of the wind is deflected upward by the network of trees. An air-cushion forms on the windward side of the belt, effective outward to a distance of about three times the height of the belt. On the lee side, protection is felt as far as twenty times the height of the trees. If the orchard is wide, auxiliary hedge rows of spruce may be planted. These should run north and south at distances of 100 to 160 feet apart. It is well to be generous in providing a thick shelter for orchards on the Canadian prairies.

Fig. 4. Dugout reservoir for orchard irrigation, Experimental Station, Morden, Man.

A portion of the wind rolls along on the ground in waves. This is but a small proportion of the total air movement, and is usually relatively light in velocity on reaching the orchard. Another portion enters the tree belt branches. There it is slackened and bent. This bending causes eddying which

deposits the snow being carried. The main wind, inclined upward by the snowtrap hedge, swirls into eddies and much of its load of snow should fall before the air is again sloped higher by the main windbreak. Windbreaks are the first requisite in successful fruit growing on the northern prairies, and are very closely linked with the next limiting factor, moisture.

Water

The two chief limiting factors in prairie fruit growing are extremes of temperature and rather scanty rainfall, the latter being only slightly less important than prolonged low winter temperatures. Happily, the fruit grower can do much toward the welfare of his trees in the matter of soil moisture supply.

Horticulturists in the interior of the United States consider that a region with less than 20 inches of rainfall annually must be irrigated for successful fruit culture. This means that only a small part of the prairie provinces enjoys sufficient rainfall to furnish the full needs of fruit trees. Many local farmers assure themselves of the required water for irrigation by impounding snow water in a dugout reservoir, or by tightly damming a draw or watercourse to form a deep pond of springtime runoff waters.

A tree needs large quantities of moisture. It is calculated that about 500 pounds of water are required to produce one pound of dry matter. The demand for soil moisture by a plantation, which has been developing only leaves, shoots and roots, may be doubled when fruit production commences. In other words, an orchard has greatly increased water requirements when it reaches fruitfulness. One to three heavy irrigations each season will materially benefit the average prairie orchard. Where the available soil water is insufficient, the constitution of the tree weakens, and damage from insects, disease, and winter injury may result.

Small showers add little to the soil moisture supply. On the other hand, a heavy rain of short duration may be largely lost by surface runoff and by deep percolation into soil cracks. This explains the value of maintaining a lumpy surface on the soil by timely use of the cultivator. In general, only one-third of the season's rainfall will be utilized by the plant, another one-third will be lost in surface evaporation, and the remainder escapes by runoff or penetration into deep crevices. An efficient windbreak will partly control evaporation, since evaporation is directly proportional to the velocity of the wind. Trees lose water by evaporation even in the middle of winter. If their tissues are lacking in sap, killing by sheer drying, or what is termed physiological drought, may occur. The moisture content should be not less than 45 per cent of the weight of the branches at any time of the year.

Heat

Cold is commonly defined as the absence of heat. There is a general impression that tree fruit growing on the Canadian prairies is restricted mainly by the considerable below-zero weather encountered in December, January, and February. Undoubtedly prolonged severe winter cold frequently does result in black-heart, root injury, die-back, and even the death of fruit trees. On the other hand, orchardists in frigid Northern Siberia report success in growing large apples by training the branches close to the ground. Apparently this is a system of parallel cordon treatment. The branches, being near the ground, catch snow and can be covered with soil or other mulch if necessary.

Shelter tempers not only the piercing winter winds, thus moderating the severity of the cold, but also the dessicating blasts of summer and the drying effect of winds at all seasons. When soil water and sap moisture are ample, the intense cold of midwinter and the parching heat of July will be less damaging to the orchard.

In most areas of the earth heat is recognized as the chief climatic factor that determines the range of plants grown in the various zones. The fruit grower cannot exercise so much control over temperature as he can over shelter and water supply, but at times he can effect some improvement.

Fruit trees in bloom sometimes lose much of the prospective crop through late spring frosts. Such injury is likely to be most severe in 'air pockets', or islands of calm air. At a temperature of 29°F. there may be minor or major injury depending on the duration of the cold spell, and on other associated circumstances. Sprinkling the blossoming trees with fine spray early the next morning helps to decrease the loss of plant moisture through evaporation. On a night when frost threatens to harm the blossoms, straw, refuse, or brush may be burned on the windward side to produce heat and a canopy of smoke. In commercial fruit districts special fire-pots or oil-burning orchard heaters are sometimes employed. A similar scheme is to cultivate the orchard with a spring-tooth implement late on the afternoon preceding a night for which frost is forecast. This helps because it exposes more soil surface to give off heat by radiation, and the deep grooves enable heat to rise from the lower soil levels.

Late varieties of apples and plums may not be ripe when autumn night frosts arrive. Fortunately apples such as Haralson, Manton, and Prairie Spy will withstand several degrees of frost. Plums are more sensitive, and it is wise to plant only those strains that ripen for harvest by mid-September.

At soil temperatures lower than 10 to 11°F. fruit roots are in danger of freezing. The most efficient conserver of heat in the soil is a blanket of snow. The earlier in winter it comes the better. If the shelter is inadequate, it pays to run a snow-plow through the orchard promptly at intervals to provide a raised furrow of snow. This will collect moving snow and induce drifts to form. Mulches of strawy manure, moss, or cover crops form an insulating covering over the soil and catch snow, thus protecting roots and tree crowns. With such coverings there is danger of damage from mice.

The simplest and most completely successful method of avoiding injury and loss from extremes of temperature is to plant the very hardiest varieties of fruits consistent with acceptable fruit quality, and have these grafted to rootstocks of ironclad constitution.

Plant Growth

In the plant world much still remains a mystery. An apple seed is planted, but does not germinate until a chemical change extending over a period of several weeks, and known as the "after-ripening" process has occurred. This process takes place only under favorable conditions of temperature, moisture, and time. Then the tiny shoot and initial root appear, followed by the development of leaves. Soil moisture, carrying nitrates and other mineral salts in solution, is absorbed by the root hairs, enters the rootlets and roots, and is forced upwards on the wood side of the cambium layer and into the leaves. There, in the sunshine, with two of the gases drawn from the air, the soil solutions are manufactured into the complex green materials, the chlorophylls. The elaborated food is distributed downward on the outer or bark side of the cambium layer, that thin growing layer on the outer ring of wood, and feeds the tissues of work, bark, bud, and root. Thus "growth is from above downward", that is, starting from the food factories, the leaves.

The big flush of growth occurs in May and June. In late July or in August the terminal bud takes form. Then the shoots stiffen as the cell walls thicken and food is stored in the tissues for more new growth next April. To outward appearances growth has stopped for this season, but dig a tree in early September and it will be seen that thousands of little

white rootlets are being put forth. This is one af the reasons why early September transplanting of fruit trees and bushes has a real advantage. Moved then, new roots have time to develop and so re-establish the subject before winter sets in. There must be ample soil moisture present. However, under prairie climatic conditions, only the bush fruits and the very hardiest tree fruits are constitutionally adapted to autumn transplanting.

The young tree grows vigorously next season, building an expanding skeleton and extending its stature in all directions. There will be no fruit until the plant has reached a stage where there is a favorable balance between the proteins, or nitrogenous compounds, and the carbohydrates, or starches and sugars, in its composition. This is expected to occur in a sand cherry the second year, in a plum and apricot about the third to the fifth year, in a crabapple the fourth to the seventh year, in apples the fifth to the tenth year, and in pears and black walnuts about the sixth to the eleventh year. Exceptions may occur. Where trees continue strongly vegetative, action may be taken to hasten fruiting either by ringing or girdling branches or by root-pruning. Pruning the top would still further delay fruiting.

Flower buds require sunlight for formation. That explains, at least in part, why dense bushy trees may bear scantily, particularly on their inside portions. They require pruning to thin out the branches and so permit sunshine to enter. Tree rows will have better distribution of sunlight if they run north and south rather than east and west. Flower buds are differentiated from leaf buds usually in late May and during June. If the weather tends to be dry at this season, vegetative growth is reduced, and the development of flower buds is encouraged because there is a store of nutritive materials for them. In contrast, plentiful soil moisture stimulates strong growth of shoots and leaves. This process uses up food reserves that otherwise would be available to induce the buds to develop flower parts. The result is that only leaf buds are formed.

Production of a large load of fruit puts a heavy strain on the tree. The forming and filling of seed and flesh drains food supplies from the storage tissues. This activity weakens the tree and it may be greatly injured by frost if the succeeding winter is a severe one. Nature attemps to safeguard the tree by sloughing off much of its overload of fruit early in summer. This is the so-called "June-drop". There is often need to supplement this natural dropping by practising hand thinning during June on those trees that have set too bountifully.

Roots range much farther than is commonly realized. Dr. A. F. Yaeger investigated tree roots extensively at the North Dakota Agricultural College. He revealed that the roots of most broadleaf trees, such as elm, ash, poplar and many others, extended out from the trunk a distance approximately equal to double the height of the tree. This means that a tree 20 feet tall might have roots in a radius of 40 feet or a diameter range of 80 feet. Conifers tend to have a root zone stretching laterally for a distance equal to the height of the tree. Roots of the Amur tamarix, a dry-land plant, are intermediate in root length. The length of woody roots explains why transplants close to established trees are not very successful. Moreover, the distinctive root-growth pattern is another reason for having spruce as the inner row of the orchard windbreak.

Site Selection

The first consideration in choice of a site for the home orchard is that of convenience. If growing conditions are favorable for the fruit trees, proximity to the house is obviously an advantage. Conditions that are particularly suitable include sheltered surroundings, sloping land above a

valley, a northeastern or eastern exposure, the presence of large bodies of water, a moderately fertile sweet topsoil with a pervious subsoil, free surface drainage, and a fairly level surface within the orchard to facilitate irrigation.

Shelter is Essential

If the farmer possesses a piece of natural bushland, a clearing for the orchard made therein may suit the purpose very well. Lacking such woods, it will probably be necessary to plant a windbreak and snowtrap hedge. The shelter should have reached a height of about 6 feet before setting out the fruit trees. Where fruits are to be planted at once, temporary shelter may be gained by using snowtrap slat fencing like that placed along highways to control winter snowdrifts. Planting double or triple rows of flint corn or Sunrise sunflowers in and about the orchard gives auxiliary shelter. It is important that the shelter be sufficient to control drifting snows. A drift forming over the fruit trees may ruin the orchard by snow-crush. As the drifts settle during early warm spring days and freeze to the branches during nights, they may break off most of the main branches and so wreck the tree.

FIG. 5. Snowcrush damage to a row of plum trees when no snowtrap was provided.

Air Drainage

Some of the most successful prairie fruit plantations are set on a slope well above a deep valley. Cold air, being heavy, settles in the lowest levels, while lighter warm air from the valley rises up the slope. There is a vital advantage in having such decided air drainage. Late spring and early autumn frosts may be destructive in the valley, but may miss entirely the orchard on the upper slope. Significantly higher winter temperatures are experienced in such an orchard.

Exposure or Direction of Slope

A northeastern or eastern slope is the best. Trees there are protected partially from the winter sun and from drying westerly and southerly winds.

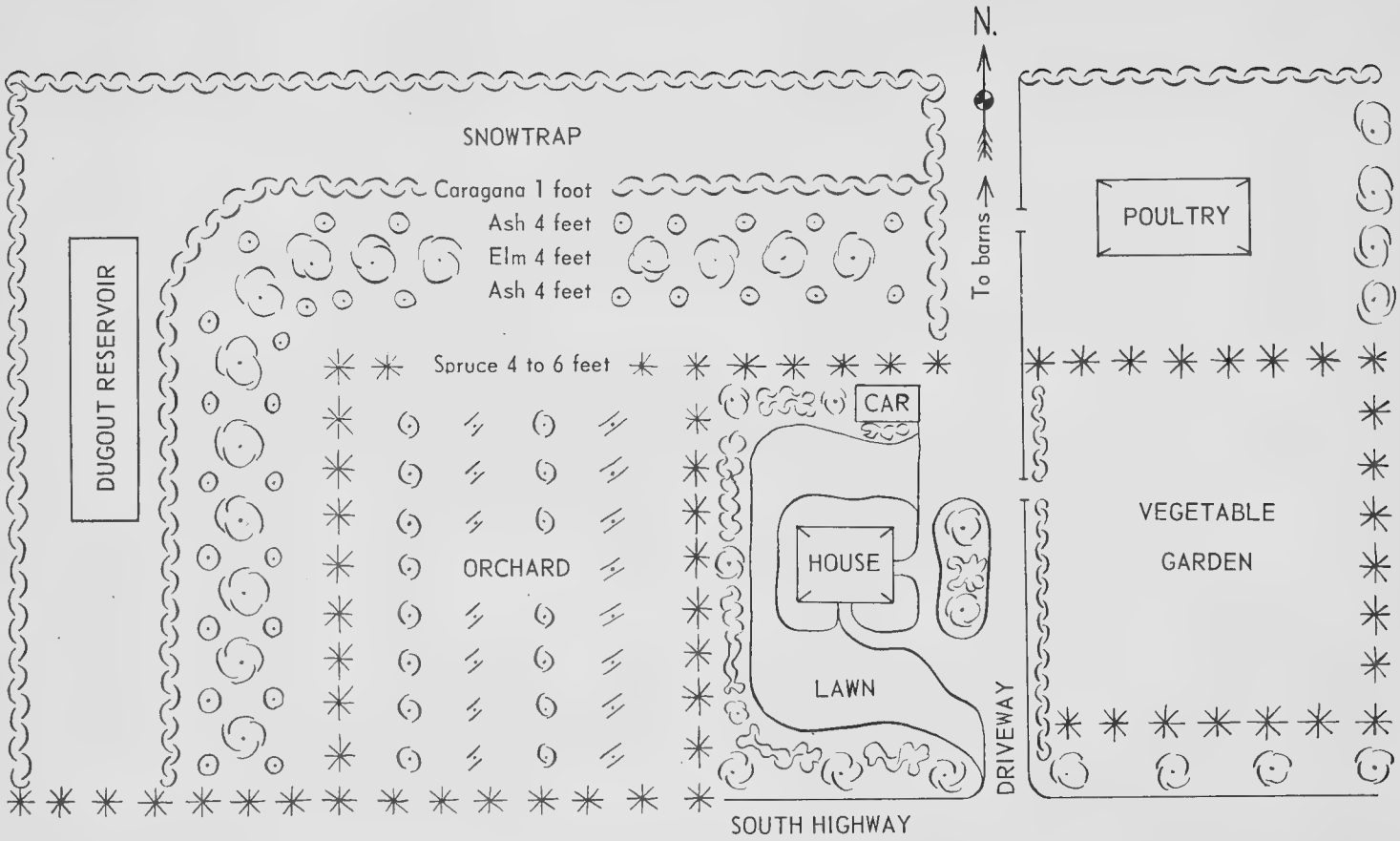

FIG. 6 The orchard is convenient to the house and close to the dugout reservoir.

They retain snowfall well and bloom somewhat later in spring and, consequently, are less subject to frost injury to blossoms. A southwestern slope is very unsuitable for prairie fruit trees. The hottest sun is considered to be about 1 to 2 p.m. The March and April sun strikes the tree trunks nearly perpendicularly. These and other sun rays reflected from snow to bark, cause injury by sunscald. Orchards on southern and western slopes are subject to drying out, early blooming, and heaviest winter injury with subsequent invasion by borers and other insects.

A large deep lake, particularly on the western or windward side, is of much benefit. Water is a poorer conductor of heat than earth and so moderates temperatures. Prevailing winds fanning the water lower the daytime and raise the night temperatures in the orchard and also increase atmospheric humidity. One precaution should be observed. If the water surface is southwest of the fruit trees, sunscald is likely to be severe unless a tree screen intervenes to filter the sun's rays reflected from the ice.

Soil

Fruit trees tolerate a wide range of soils, but they require soil that is sweet, deep, moderately fertile and well drained. An area with free alkali in the soil is unsuitable. Most varieties prefer earth that is somewhat acid in reaction. However, land that grows corn, wheat, and gardens satisfactorily may be considered well adapted to hardy fruits.

The subsoil is probably even more important than the topsoil. It should be porous so that roots may penetrate it readily and water move through it freely. Cold heavy gumbo or hardpan at a depth of 3 feet or less makes a bad situation. Rooting will be shallow and the moisture reservoir too limited. The other extreme, a subsoil of lean sand or coarse gravel, allows surplus moisture to sink away deeply, does not anchor the trees well, and predisposes the trees to winter injury, scanty production, and short life

An area of loamy soil underlaid to a depth of 6 feet or more with friable. medium clay loam subsoil is very favorable. Heavy clay soils may handicap the trees because such soils are naturally cold, prevent good root penetration, and also cause late autumn growth thus predisposing the trees to tip-killing. Sandy soils are early, tend to produce highly-colored fruit, but are droughty and require frequent waterings by rain or irrigation.

Pears and native plums will succeed on moderately heavy clay loams. Apples and Japanese plums mostly prefer lighter clay or sandy loams. Apricots do well on fertile sandy loams. Sand cherries are the only orchard plants that succeed on sandy land.

Establishing the Orchard

Plan and Arrangement

When the location for the orchard has been chosen, a sketch of the area should be made on paper. Later the sketch should be reproduced in a record book and the name and date of each tree planted recorded. This will provide a permanent record of the identity and history of the trees in the orchard.

The extent of the planting will vary widely. However, every plantation should have two or more varieties of each type of fruit to assure satisfactory cross-pollination. Crabapples and apples are considered here as one type for they pollenize each other effectively. A parallel relationship is found in plums and cherry-plums.

Trees in home orchards are usually set on the square system—a tree being set at each corner of the square. The number of trees required to plant an acre is dependent upon their spacing. Planted 25 by 25 feet, the number is 70 trees; 22 by 22 feet, 90; 20 by 20 feet, 108; 18 by 18 feet, 134, and 16 by 16 feet, 170 trees. Having all trees set on the square facilitates cultivation. However, in mixed fruit plantations the square system is usually modified, because stone fruits require less space in the row than apple trees.

Spacing

Spacing in prairie gardens will vary with conditions of moisture supply, growth habit of trees, and personal choice. The advantages of close planting are that the trees supply shelter to each other and lessen snow drifting. The disadvantages include greater competition for soil moisture, poorer distribution of direct sunshine, smaller fruits, and less convenience in spraying. Where rainfall is scanty and irrigation is not available, moderately wide spacing is indicated.

It seems well to have the rows of the larger fruit trees 20 to 25 feet apart. In the row, apples and crabapples may be placed 18 to 25 feet apart; pears, 16 to 20 feet; apricots, the larger types of plum trees, Morello cherries and black cherries, 16 to 20 feet; cherry-plums, 12 to 20 feet; Manchu or Nanking, Korean, dwarf bush, and sand cherries, 8 to 12 feet; black walnuts, butternuts and Manchurian walnuts, 20 to 30 feet; mulberries, elderberries, buffaloberries, saskatoons, pembinas, and filberts, 12 to 16 feet. All fruit trees should be 25 to 40 feet from the inner row of the windbreak to avoid root competition.

The direction of the rows is not a factor when rows and trees in the row are equidistant. If close planting is practised, there is a decided advantage in having the rows run north and south. Sunlight is then more generally distributed about the trees.

Arrangement of Trees in the Row

It is better to have the pome fruits, such as apple and pear, together, and the stone fruits, including plum, cherry, and apricot, in another group. Having mixed types in one row is less economical in terms of labor and of combating insects and diseases.

Interplanting of vegetables and berry fruits between the rows is desirable until the fruit trees require all the soil moisture. While the trees are young the rows may be interplanted with native fruits, such as saskatoon, filberts, sweetberry honeysuckle of select native strain, gooseberries, or currants. These bushy subjects not only protect the soil by shading but also thicken the shelter of the plantation.

Labels

Labels should be used to identify each tree. The small wired wooden tree label attached to the specimen when received from the nursery should be removed after planting. Otherwise, failure to loosen the wire from time to time may result in choking off the top of the tree or the branch to which the wire is attached. There are many different methods of labelling. The newly-set tree may be marked by a wooden stake 1 by 2 inches, 24 inches long, painted green with the data lettered in white paint or enamel. Another scheme is to have the name written or etched on a strip of zinc tacked to the stake. Some growers depend upon a narrow strip of zinc, with the information written in lead pencil, loosely rolled around an inner branch of the tree. This will prove durable for years.

For established trees a section of planed lath about 8 inches long with two holes bored in each end may be used, with a length of copper wire about the thickness of baling wire threaded through each pair of holes to fasten the

label to the branches horizontally and at eye level. The lath may be covered with aluminum paint, lettering in black enamel, or simply painted with outside white paint and lettered with a heavy graphite lead pencil. If the lettering is done while the paint is still wet, the black of the pencil will become fixed in the drying paint and the writing will be legible for a number of years. If a coat of clear outside varnish is brushed over the face of the label all writing on wooden labels will last longer. In all cases the most important record of individual trees is that in a book in the house.

Time of Planting

Theoretically early autumn is the best time to plant fruit trees. Young nursery trees dug in early September, stripped of their leaves and planted, may be expected to put forth some new roots and so establish themselves by the time winter comes. Such trees should be ready to recommence new root growth the following spring, some days before the ground is dry enough to dig. The Canadian prairies, however, have an early, long, and severe winter. Autumn-planted trees are subjected to drying frosts and winds, and are liable to winterkilling. If autumn planting is practised, the trees should be thoroughly watered in mid-October and hilled up with a foot of earth before freeze-up in November. The following April this protective mound of earth should be levelled. Only the hardiest types of fruit trees should be risked in the trying ordeal of autumn planting.

Spring is the safest time to transplant orchard trees on the prairies, with April the most favorable month. Then the stock is dormant, the ground moist and cool, and a long growing season lies ahead. The new tree gets a better start when planted before the hot days, warm winds, and drying soil of May. Farther south, where growing seasons are longer, later planting may prove practical provided the planting stock has been kept dormant.

Nursery Stock

Most growers find it satisfactory to buy their fruit stock from a commercial nursery. The order should be placed early with a reliable firm having a reputation for growing and delivering vigorous, healthy stock, worked on hardy seedling roots, true-to-name (which is a factor of major importance), and for shipping the stock well-packed, and promptly on the date agreed upon. It is wise to deal directly with an established nurseryman in prairie territory rather than through unknown travelling salesmen. Local nursery stock will involve lower shipping charges, should be a minimum time en route, and will more likely be built on hardy roots than will imported stock.

Three or more varieties of each type of fruit should be ordered. Varieties selected should be approved for the district by the Provincial Horticultural Society and varieties substituted without prior approval should not be accepted. Recommended lists of varieties, rated as to climatic zones, and also addresses of fruit nurseries are available from Agricultural Representatives and from Experimental Stations. Often it is helpful to confer with successful fruit growers in the district on these matters. Order in autumn or winter to avoid disappointment through the supply having run out.

One-year-old trees, well-grown, mature, and free of root galls or warty growths on the upper roots and other defects, are preferred. They are most economical, transplant easily, and are unpruned, which permits the grower to shape his own trees. Two-year-old stock is usually pruned and the lower branches removed before leaving the nursery. Any undersized, skinny tree

should be regarded with suspicion. It probably has an inefficient root system, carries disease, or possesses some other handicap. A strong, branched root with a smooth union between root and scion is a prime qualification. Shipment should be by express or parcel post to save time and avoid frost damage.

A grower is unwise to depend upon seedling fruits. These will differ more or less widely from the mother plant, for their pollen parents are unknown, and so their qualities will be a matter of chance. Grafted or budded stock is a known quantity, and that is what is sought.

Handling Nursery Stock

When the bundle of nursery stock arrives, it should be taken home at once, opened in a shed and the roots immersed deeply in a tub of soft water for 2 or 3 hours. If the roots are dryish, the stock should soak over night. If the young trees appear very dry, they should be soaked, then buried in cool moist soil or damp moss in a sheltered shaded spot for a few days to plump up.

Nursery stock delivered in the autumn should be heeled-in in mellow earth in a sheltered spot, the trench sloping about 30 degrees. Fine earth should be worked among the roots and tramped, then more added until at least a foot of soil covers the roots. A light covering of soil should extend at least halfway up the trunk, and a generous watering should be given before the trench is filled in. At all times the roots should be kept moist. A covering of wet burlap should be used over the roots while they are exposed.

Planting the Tree

The orchard area will be well prepared if it is summerfallowed or planted to a hoed crop the season previous to setting out the fruit trees. Heavy soil can be made mellow by plowing it deeply in October and leaving it rough to expose the subsoil to frost action throughout the winter season. In the spring the surface should be harrowed down.

The next step is to lay out and stake the plot, with sharpened laths serving as guide stakes on all four sides. By sighting across and up and down on the boundary laths the location of each tree may be determined. Small tree stakes should be placed where each tree is to be set.

Digging the Hole. This operation is important for the gardener is preparing a permanent home for a tree that should prosper for a long time. Even for a one-year-old tree the hole may well be 2 or 2½ feet square and at least 1½ feet deep. If the subsoil is hard, it should be loosened up another foot deeper with the shovel. The hole should be of ample size to accommodate all the roots when spread out. In the digging, the topsoil should be kept at one side, and the subsoil spread about because it should not go back into the hole. Adding a large pailful of acid peat mixed with fine topsoil is considered beneficial for it increases the moisture-holding capacity of the soil and aids the tree roots in obtaining iron in digestible form.

In heavy clay land it is a good plan to dig the hole in the autumn, so that the soil and subsoil may become mellowed and crumbly by wintering and soaked deeply with melting snow in springtime.

Setting the Tree. In transferring the tree from its tub of water or wet burlap covering to the hole care should be taken to keep the roots damp. Any broken or ragged root ends should be trimmed smoothly with a thin-bladed sharp knife. The cut should be made on the underside of the root, and towards the end, for the cut face flat on the soil favors the branching out of new roots. After a goodly amount of moist topsoil has been shovelled into the hole, the tree may be lined up either by sighting, or with the planting-board, about 6 inches lower than the final depth.

All side roots should be spread outward, with the strongest pointing into the west as anchorage against prevailing winds. The top should be inclined about 30 degrees southwest of the perpendicular, to lessen the chance of sunscald and the tendency to become windswept to the eastward. The topsoil should be shovelled in to about 6 inches from the top of the hole. By gently jiggling the tree upward it may be eased to the proper height—not more than 1 inch deeper in clay soil or 3 inches deeper in sandy loam than it stood in the nursery. The fine soil should now be in contact with all the roots—a condition essential for their growth and functioning. The earth should then be firmed against the roots by using the back of the heel and working from the outside of the hole in towards the trunk. If the ball of the foot is used instead, the surface soil may be packed while air pockets remain below. In setting the tree it is desirable to have either a young side branch, or a strong promising bud on an unbranched whip low down on the southwest side. The latter should develop into a main branch to shade the bark on the trunk.

When well firmed, more topsoil may be used to fill the hole loosely. When tramped firmly, a depression of three or four inches should remain. Two or three large buckets of water should be added. The following day, the soil should be lightly heeled over and topsoil added to fill the hole almost but not quite level. The depression is to aid any further watering that may be required and to catch rain water. The upper two inches of soil should be left loose and untramped to form a mulch against evaporation. The wire tree label should be removed and a name stake driven in along the row two feet or so away from the tree.

Heading-Back: The task of shearing off the top of the young tree remains. There are two reasons for this. The first is that the plant has lost most of its feeder roots in the operation of transplanting and so some time will elapse before new roots develop to pump moisture into the upper parts. Therefore, the top must be cut back drastically to balance the root condition. The second reason is that successful prairie orcharding means short trunks and more or less bush-type trees. Low-heading induces dormant buds on the lower trunk to sprout and eventually form main branches.

For these reasons, apples, pears, plums, and apricots should be cut back to a height of 12 to 18 inches after planting. Sour cherry whips are slow to develop dormant buds and so may retain a height of 24 inches. Cherry-plums produce fruit on one-year wood and should be beheaded at 8 to 12 inches in height. A number of low shoots are desired. All side branches carried by the newly-planted tree should be cut back at least one-half their length and surplus branches should be cut off flush with the trunk. All cutting may be performed with a keen knife or sharp hand shears.

One very successful prairie orchardist places a short fence post on the southeast side of each new tree. This protects it against early springtime sunscald and also provides an anchor when the tree requires strengthening against westerly winds. The tree trunk is looped in a band of burlap nailed to the post.

Pruning

Fruit trees are pruned for the following reasons:—(1) to assist the newly planted tree in its re-establishment and so that lower main branches may rise from near the ground thus making a low-headed form; (2) to remove dead wood; (3) to eliminate watersprouts or suckers and old spent spurs (watersprouts are the fast-growing upright shoots that often spring up from the trunk); (4) to keep underbranches off the ground; (5) to prevent crowding and interfering cross branches; (6) to let sunlight into the tree; (7) to make spraying economical and efficient, and (8) to develop a shapely tree that is structurally strong and not blown eastward by the prevailing westerly winds.

Pruning and Training the Apple Tree

Under weather conditions on the northern prairies, it is desirable to have the tree low-headed, with a thrifty strong branch springing from low down on the southwesterly side to assist in preventing sunscald of the bark on the main trunk by filtering the sunshine in March and April. The aim is to do relatively little pruning—merely enough to allow ample distribution of sunlight, to remove weak, injured, and troublesome branches, and to train the tree to a desirable shape.

The scaffold branches should be well distributed around the trunk so that they will not grow together and girdle the leader; and a vertical space of at least 6 to 10 inches should be left between the main branches. The

FIG. 7 Left: A sturdy apple tree in excellent condition. The low branch, which is on the southwest side, gives protection to the trunk. The broad crotches are desirable. Right: An apple tree with main side branches in a whorl, with the result that the central stem or leader has been girdled and dwarfed. This tree will break apart prematurely.

branch with the wide-angled crotch should be retained when one of two branches is to be removed; and a substantial proportion of lateral branches should be allowed to develop on the southwest side of the trunk. All cuts should be made flush with the bark to permit prompt healing. Stubs die because they are without leaves to feed them, and the resulting dead wood predisposes the tree to entry of rot organisms and so shortens its life. Sharp, clean tools should be used; and all wounds over 1½ inches should be treated promptly with a protective dressing. All major pruning should be done in March, April and May.

December pruning is likely to result in severe winter injury, for not only are the wounds exposed to freezing but drying winds accentuate it. June pruning also has an adverse effect. The big flush of growth is then occurring, and the loss of new growth is a set-back as the terminal one-third of the twigs is considered richest in nutritive materials. This is one reason for thining out whole laterals rather than wholesale heading-back.

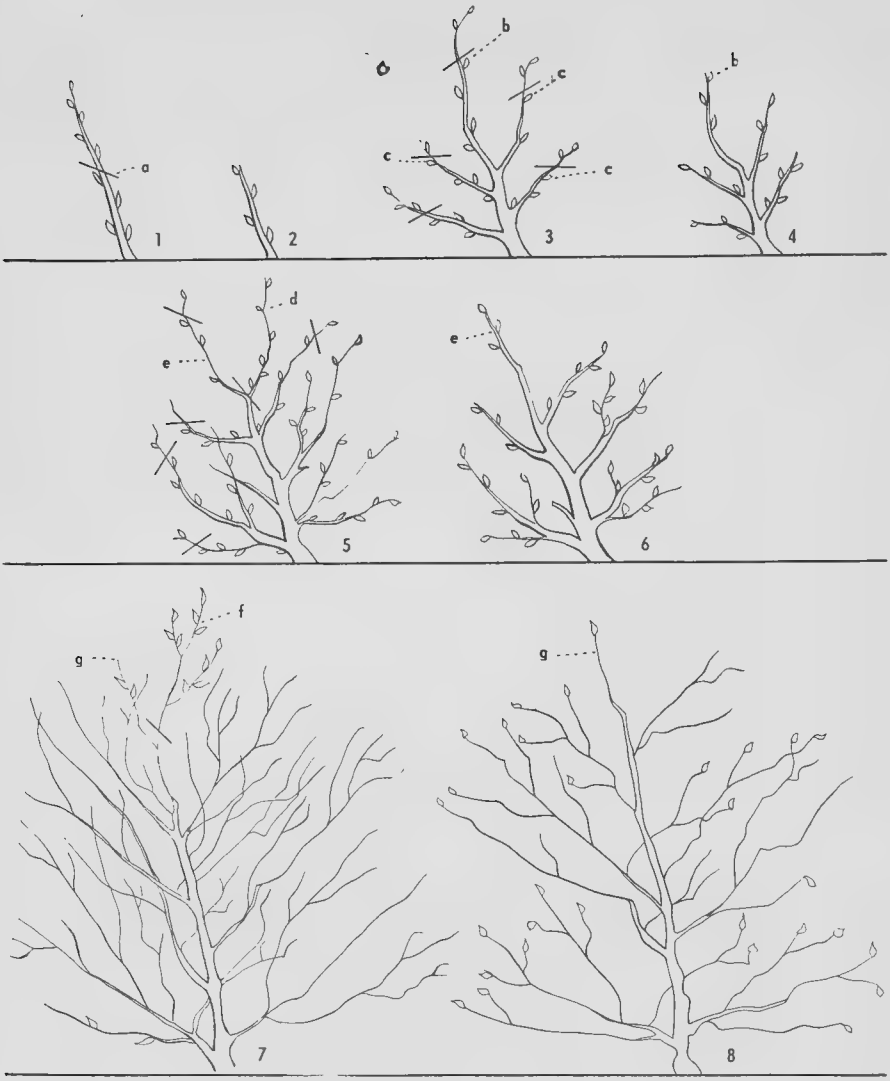

FIG. 8. Shaping the young apple tree. No. 1 is a one-year whip headed back to from 12 to 18 inches to induce low main branches. No. 3 shows an inclination of the leader to be windswept toward the east. It is cut off at b, a bud on the east side. This bud develops into a new leader causing the next lower bud, which is on the west side, to form a shoot away from the trunk. In No. 5 this western shoot is e, and the leader d is cut off so that e, growing into the wind, becomes the new top of the tree. (Lower branches are mostly cut to a bud pointing outward as c points in No. 3.) In No. 7 the leader, f, is inclining eastward so is cut back to the base of g which is growing as desired into the wind. No. 8 shows that the young whip which was slanted into the southwest at planting is assuming a more upright direction. The trunk is protected by having its lowest branch on the southwest side.

First Year: A well-grown whip is preferred by many planters. It should be headed back at a height of 12 to 18 inches, cutting to a bud on the west side. Although pruning usually has a definitely dwarfing effect, such is not the case in the newly-set tree. It must have the top curtailed heavily to help compensate for the major loss of feeder roots through digging for transplanting. Such pruning brings balance and favors early establishment of the young tree. (Fig. 8—1 and 2.)

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If a branched two-year-old tree is planted, a low stout lateral should be retained on the southwest side. This may arise as low as ground level but must be above the graft union. Two to four other desirably placed laterals should also be left. Other side branches should be removed. The terminal should be cut back to a west bud at a height of 12 to 18 inches. The laterals retained for scaffold building should all be cut back at least one-half their length and usually to an outside bud.

Second Year: The terminal growth should be cut off a short distance to an east bud. As the topmost bud has a strong tendency to grow perpendicularly, the next bud is encouraged to develop its shoot outward from the leader. Thus, in Fig. 8 in No. 3, shoot *b* is as desired—growing away from shoot *c*. The laterals should be cut back to retain balance, cutting to buds leading to the desired direction for subsequent extension growth.

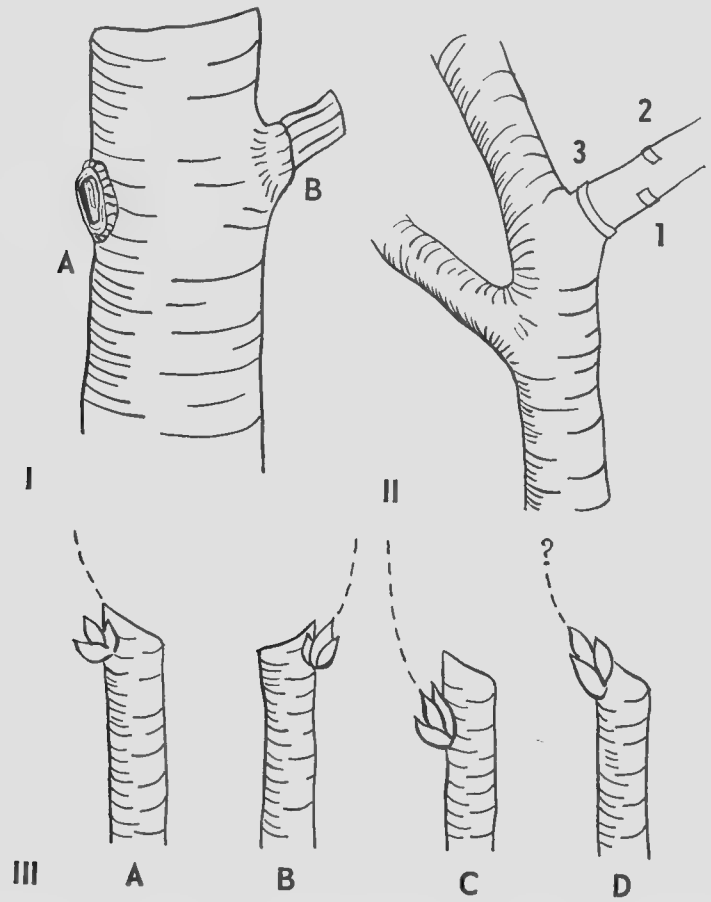

FIG. 9. I. Cutting off side branches: A on the left is well pruned, flush with the surface of the trunk. The wound is fully and neatly healed. B. The branch on the right is an example of poor pruning. The stub is unfed, cannot heal, and will soon die. The decaying wood will provide entry to disease. II. Cutting off a large branch: Downward tearing of bark and woody tissue on the parent branch may occur unless care is taken. (1) Saw from below, half way through; (2) saw off the branch; and (3) remove the stub flush with the surface of the trunk. Then smooth the wound with a knife or chisel. III. Cutting back a small branch to a bud: A and B illustrate good practice as to the position of the cut. The new top shoot will commence growth to the left or right according to the placement of the bud on the shoot. C is cut too far from the bud, tending to leave a dry stub. D is cut too close. The bud may be rubbed off or may dry out and die.

Third Year: The leader shoot *d* (Fig. 8, Nos. 5, 6) should now be cut off leaving shoot *e* as the new leader—strongly angled into the west from whence come most winds. Surplus side branches should be thinned out leaving those with strong wide crotches. The tree that was set into the windward southwest will gradually assume a more upright direction with age.

Later Years: If the terminal becomes windswept eastward, it should be cut back to a high westerly lateral (Fig. 8, No. 7, *f* should be removed establishing *g* as new leader).

Pruning should be to maintain balance. Where a branch is becoming overly large, it should be dwarfed by removing most of its laterals. A hard cutting-back is harsh treatment and tends to promote numerous crowding new side growths close to the cut. This over-abundance of lateral shoots makes for sharp angles that mean weak crotches. The surplus shoots need cutting out. This loss of wood slows up the tree. The preferable thinning method decreases growth by removing many leaf-bearing shoots.

Heavy pruning at one time tends to over-stimulate the tree causing much succulent growth. Such a condition predisposes the tree to fireblight disease. Watersprouts or trunk suckers, being sappy, are hazards for fireblight so should be removed as soon as noticed. When a big tree presents a large job of pruning, it may be best to extend the task over two or three years.

Any tree that continues to be unthrifty or becomes a cripple from severe winter injury, disease or insect damage, should be dug out and burned. A weakened tree seldom is capable of regaining full vigor. Its weakness favors the invasion of diseases and insects. "When in doubt, take it out". It should be replaced with a thrifty young tree.

The bearing tree usually shows from 5 to 8 main scaffold branches. Crotches having a 45-degree angle are satisfactory but those of broader 60- or 70-degree attachment are still better. When two branches compete for leadership, a sharp angle results. The remedy is to cut one out or cut back the less important branch one-half, thus subduing it so that it becomes a side branch of the other.

Unpruned trees are the largest because they have lost nothing. However, some periodic pruning of apple trees even when grown in semi-bush form on the prairies is essential for successful fruit production.

Pear Pruning

Pear pruning is essentially like that of the apple. Relatively less wood should be removed from the second year until bearing commences. If the tree becomes spindly or overly tall, the terminal growths should be headed back lightly. Many pear trees have a definitely narrow upright growth habit. When bearing starts the branches spread out considerably. Pruning of winter-injured trees should be delayed until May so that cutting may be made to a thrifty bud or shoot, as shown by leaf development at that time. Pears are notorious for fireblight disease. Hence, moderate rather than rampant growth is desired.

Plum Pruning

The "modified leader" system should be adopted in plums. The main branch should be permitted to grow freely for two or three years before being restrained in length. This promotes wider, stronger crotches on the main lateral branches. After a strong framework of scaffold limbs has been developed, the leader should be modified by heading back. This keeps the tree from becoming too tall. At planting time heading back may be 18 to 30 inches. The aim is to select 4 to 8 well-placed scaffold branches so as to avoid bad crotches.

Pruning the plum is a much less important task than pruning the apple. Good results may come from no pruning after the first spring. However, moderate removal of thin, weak, and troublesome branches, and tipping of long straying shoots is helpful. A symmetrical top should be the aim. A long willowy branch may be pinched back lightly in July. Unless it is encouraged to stouten, such a branch is likely to split off when bearing or if hit by storms. Upright forms should be pruned to induce spreading, and wide spreading forms should be pruned to upward buds.

Too much pruning of the plum is bad policy, and large wounds may fail to heal. Rejuvenation after the removal of large branches does not occur so readily as it does in apple trees. A little light annual pruning is much safer than any severe pruning. Weak trees should be replaced with young ones for plums coming into bearing early. All suckers from the roots are robber growths. If they grow, it is at the expense of the tree and the fruit crop.

Sour Cherry Pruning

The young plant should be headed to about 24 inches, with the lowest main branch developed on the southwest side. Weak and poorly attached laterals should be cut off. Care should be taken lest two or three neighboring scaffold branches grow into union thus forming a whorl that chokes off the main stem. After the first pruning, light corrective thinning out is the main object. Scaffold branches usually number five to seven. Large cuts should be avoided because they rarely heal over.

Sand Cherry Pruning

Pruning this type of fruit tree differs from that of others. Sand cherries and many of the cherry-plums, such as Sapa and Manor, bear most of their best fruits on one-year shoots. The pruning resembles that of black currants. Old branches should be cut off near the crown to promote new strong whip-like growths. Two- and three-year wood should be cut back heavily to promote an annual renewal of young wood. If the sand cherry and cherry-plums are not pruned severely they tend to be relatively short-lived in prairie gardens. With the method suggested, bushes are kept low. This has the added advantage of decreasing the danger of winter injury to a semi-tender variety such as Sapa.

Apricot Pruning

Training the apricot is very similar to training the plum, with the modified leader system in favor. A short trunk may be obtained by heading back to 12 to 24 inches. Where numerous laterals grow, the inferior shoots should be cut out in spring or rubbed off in summer in order to concentrate growth in the desired branches. Long laterals should be headed back to preserve balance. Pruning on large trees is essentially a matter of thinning out to keep the centre of the tree open to sunlight.

Cordon Training

Cordon training of fruit trees is performed in cold parts of Siberia so that apples can be grown. The planted young tree is cut off near the ground. Two side branches are allowed to grow. These are attached to a horizontal wire so that they are parallel to the ground and at a height of 2 feet or less. Each spring the new growths are cut back to spurs. The fact that the plant is close to the earth assures maximum heat and also the protective covering of winter snows.

Espalier Training

Espalier training involves keeping all growth in one plane. Side branches are trained flat on a trellis or wire fence. This method of training involves much work but has the merit of permitting the person with a small property to grow some high quality fruit.

Pruning Tools

Good tools are a factor in performing efficient work. Suitable pruning tools kept sharp, clean, and in keen working order encourage the workman to work with care and pleasure. Tools recommended include a thin-bladed strong pruning knife, hand shears or secateurs, a pair of large shears or loppers, a swivel saw with adjustments at each end of the blade for making cuts with the blade turned at the desired angle, and a chisel about 1 inch wide. The chisel, knife, and hand shears will do for all the work on young trees. The saw and large shears are required for larger wood. The chisel makes for clean, quick cutting of branchlets flush with the branches.

Treatment of Wounds

Treatment of pruning wounds is important. Untreated large cuts such as those over one inch in diameter tend to dry out and become checked, or lined with cracks, thus allowing rot organisms to gain entrance to the tissues of the tree. Smaller cuts, properly made, usually heal rapidly without wound dressing. A dressing for wounds should not injure the cambium; should be durable against exposure to the weather; maintain a continuous surface; be elastic enough to bridge checks that may develop in the wounds; adhere to the fresh tissue; be repellent to fungi and insects; be inexpensive and readily obtainable, and should be inconspicuous and preferably dark in color.

A wide variety of dressings have been tried. The most commonly used is made of white lead and linseed oil mixed to a paint of creamy consistency and darkened with lamp black. Paints with turpentine, benzene or gasoline in them should be avoided because these substances are likely to injure the growing tissue. Coal tars should not be used for the same reason. Grafting wax (three pounds resin, one pound beeswax, and ½ pint linseed oil) is approved, but will require retouching if it peels from the wood. Bordeaux paste (composed of bordeaux powder mixed into raw linseed oil to form a creamy paint) is considered one of the best dressings but may prove less persistent than desired. Orange shellac, and waterglass (sodium silicate) are helpful but lack durability against weathering. All the aforementioned are applied with a narrow paint brush.

A recently discovered dressing of water-soluble asphalt appears to be the most serviceable. It lasts fairly well, is elastic and pliable, and is non-toxic to the wood. Application is with a paddle or spatula. Asphalt-water emulsions are offered in the trade under such names as Braco, Tree Seal, Flintcote, etc.

None of the dressings mentioned prevent bleeding, nor do they cure decay of wood that has set in under the wounds of winter-injured trees. However, all large pruning wounds deserve smooth trimming and a dressing of asphalt-water emulsion, bordeaux paint or darkened white lead and oil. If the wound is to be disinfected before the dressing, a solution of mercuric chloride (corrosive sublimate) in a strength of 1 to 1,000 is applied.

Minnesota authorities recommend painting the edges of the cut bark around the wound with shellac; then painting the remaining wood portion of the wound with a preparation consisting of a mixture of lanolin, raw linseed oil and potassium permanganate. This treatment promotes rapid healing.

Even with the most considerate treatment it may prove difficult to heal the pruning wounds of winter-injured trees. Usually it is best to dig out those trees that are badly injured by winter and replace them with thrifty young trees.

Supports

It may be necessary to support a tree either to keep it in the desired position or to prevent breakage of branches carrying a heavy load of fruit. A tree may become loosened or a main anchor side-root severed so that the head tilts with the wind, or the variety may become too heavy for the dwarfing root upon which it is grafted. Then one, two, or three stout stakes should be driven into the ground and a hammock of burlap or canvas tacked thereto, with the loop supporting the trunk of the fruit tree. If three stakes at 120-degree positions each carry a comfortable cloth support to the tree, the roots will be relieved of strain and the tree will benefit.

Laden branches may break with the weight of fruit, or touch the ground. Effective supports may be made of crotch-topped willow stakes or by 1- by 4-inch boards notched at one end. In July it is well to have a supply of supports of varying lengths. The supports may be gathered in October and stored in the form of a teepee in a convenient location to be used again the following July.

Cultivation

The reasons for cultivation of the fruit plantation are: (1) to conserve moisture in the soil by eliminating weeds and causing a dust mulch that fills cracks; (2) to facilitate aeration which is prevented when soil becomes compacted; (3) to supply nutrients for good growth; (4) to break up crusts on heavy soils, leaving the surface lumpy so that rains will enter and not run off over the hard earth, and (5) to aid in the control of certain insect pests.

Clean cultivation is practical in prairie gardens as the moisture supply is usually less than is needed by the fruit trees themselves. In wetter climates the orchards may be in sod or partial sod. However, permanent grass sod is unsuitable for the prairies with their low rainfall.

As soon as the earth dries sufficiently in spring the surface should be cultivated. This kills overwintering annual weeds such as stinkweed, lets air into the soil and, by stimulating chemical action, frees plant nutrients. It is desirable to obtain a vigorous growth in the early season. Cultivation should be stopped by mid-July so that tree top-growth ceases and the wood hardens up before heavy frosts occur.

Depth should be the minimum to accomplish the purpose. Deep cultivation is sure to injure feeder roots which are mostly in the upper 12 inches of soil. Plowing is seldom necessary after planting. Thereafter cultivators and disks are adequate.

Implements and Tools

A small garden tractor, preferably one carrying a frame to which the duckfoot blades may be attached, is satisfactory. A small walking tractor is desirable for the small orchard and for working close around the trees in larger plantings. A very useful cultivator may be made by bolting cyclone-weeder blades to a plank and drawing it by tractor or horse. It works the soil to a depth of less than 2 inches. Where small weeds or purslane exist it is helpful to fasten the ends of a logging chain at the outsides of the cyclone-weeder base to drag behind in a semicircle. The links knock the adhering earth off weed roots.

A valuable hand tool is the "Harold Orchard" hoe. It is a flat seven-sided piece of tool steel made into a hoe that may be both pulled and pushed. It makes for more rapid work than the ordinary garden hoe, leaves no hollows, and is efficient in severing root suckers. Hard baked surface soil may be disked or broken up with a springtooth cultivator.

Cover Crops

Although cover crops are seldom advocated in the prairie orchard, in a rainy season where the soil is fertile and prolonged summer growth is expected, it may be wise to sow oats or oats and barley about the first of July. The grain crop will take much of the soil moisture and cause a slowing of tree growth. This may be very important, particularly in a young plantation in rich soil.

The cover crop aids in protecting the soil and the tree roots and in trapping snowfall. It also adds humus, for the oats and barley will be killed by autumn frosts and can be cultivated into the soil next May, but extra precautions against mice are required where cover crops are grown. The presence of trash on the surface is beneficial to the trees even though it may be unsightly. All cultivation may well be towards keeping trash on top, for a topping of trash decreases evaporation and diminishes soil deterioration.

Grass Mulch

Many orchardists in the East are finding a mulch culture profitable in apple orchards. A grass crop may be grown and the clippings either left where they lie or spread beneath the tree. Straw or other coarse materials should be added to make the covering sufficient to keep down weed growth. In the prairie orchard all litter must be hauled in. Materials may be straw, slough hay, spoiled hay, sphagnum moss, cut corn stover, sudan grass, or strawy manure. It will be necessary to add to the covering, usually 5 to 8 inches deep, whenever it becomes thin. The advantages are several, but the disadvantages are the serious hazards of fire and mice and the labor in gathering and spreading the litter. The mulch cover is not considered suitable for plums, apricots and other stone fruits.

Fertilizers and Manures

Most prairie orchards are on fertile soils. The problem in the early stages is often that they are too fertile, promoting late growth that is subject to injury from autumn cold. When growth in a normal growing season is less than desired, enrichment of the soil is in order. Trees that have been bearing for a few years may need added nourishment. Rotted barnyard manure is the most satisfactory. It should be applied at the rate of about a ton to 1,000 square feet. If it is spread in October and plowed under then or in April or early May, the nutrients will be available for spring growth. Stable manure contains the various elements required by the plant.

The commercial fertilizer suggested is ammonium phosphate. Prairie orchard soils usually have plenty of available potash, but nitrogen and phosphorus may be low. An application of 11-48-0 at the rate of 10 pounds to 1,000 square feet, harrowed in about the first of May, should soon be expressed in increased shoot growth and large dark green leaves.

Irrigation

Water supplies are usually too limited. Frequently there is less than enough moisture for the well-being of fruit trees in June, July, and again in October. During spells of dry weather in those months irrigation is beneficial and often essential.

For effective irrigation the surface may require grading to make it level for carrying water. The common system is to apply water four to six inches deep along open ditches. In addition to the furrow method, sprinkler, flooding, and basin irrigation may all be used in orchards. In young plantations the furrows should be about six feet out from the tree row and spaced about four to six feet apart. Water should be run down these furrows for about six hours.

If there have been no penetrating rains in September and early October, a mid-October irrigation will be very much needed. Because trees are subject to much drying during winter, roots in moist soil winter better than those in dry surroundings.

Nutrition Problems

The only nutritional trouble frequently encountered in fruit plantations on good average prairie soils is chlorosis, or "green sickness". resulting from the lack of available iron. Plants require but very little soluble iron but that little is essential for the manufacture of chlorophyll in the leaves. Usually there is a plentiful supply of iron but, if lime is present in large quantities, the iron may be tied up in forms that make it inaccessible for plant food.

Chlorosis shows up in the leaves which become yellow or whitish in place of the customary full green color. The result is a poorly nourished and weakened plant. A remedy should be promptly sought or the tree may succumb to winter injury.

The best hope is to treat the soil, using acid-reacting materials such as acid peat, sulphur, sulphuric acid, and acetic acid. Alleviation, even if not a full cure, may be expected if acid peat is filled into post-holes dug to a depth of two feet in a ring about the outer branches of the tree. Certain tree roots may invade the peat and absorb iron humate. Acid from the peat may free iron close to it. The inorganic correctives mentioned, when watered into the soil or worked into the topsoil, should free iron. However, a large quantity is required to neutralize high-lime soils and the cost is prohibitive for any large area.

The second method is to add an excess of iron to the soil. Ferrous sulphate (copperas) is promising and relatively cheap. It works in two ways—supplying usable iron and leaving an acid residue. Dr. A. C. Hildreth, Superintendent of the Cheyenne Horticultural Field Station, starts with a pound per square yard. This is cultivated and watered into the earth. If the plants do not green up in three weeks, another dose is given. The effects are cumulative and beneficial even though they may not be sufficient to correct the chlorotic condition promptly. A good practice is to bore holes in the soil at frequent intervals and fill these with the dry or the liquid ferrous sulphate salt.

The third soil treatment involves cultural management. Drainage should be provided so that excessive soil moisture may run off before it brings up and deposits alkaline salts in the root zone. Nitrogenous manures should be avoided as these promote rank growth that would require even more iron. The use of deep-rooting cover crops, as alfalfa and sweet clover, is helpful. Their large deep roots open up the soil, and, on decomposing, provide plant residue. Another benefit may come from excretions from the living roots. The best practice may be to cut the hay and leave it to decompose where it lies. By this system no plant food is removed from the area.

Trees that are severely chlorotic may be saved by putting iron directly into their tissues. The simplest application is to spray the leaves with ferrous sulphate in a two per cent solution. A more lasting treatment is to inject the iron salt, ferric citrate, into the crown, trunk or branches. An auger or bit may be used to bore holes, slanting somewhat downward. The holes, one-quarter to one-half inch in diameter, should be sunk into the wood of trunk, branches or

main roots from one to three inches deep and at intervals of three to four inches around the circumference. The salt should not come closer than about one-half inch from the top of the hole. Ferric citrate should be used at the rate of one-tenth ounce for a tree three inches in diameter. An additional one-sixteenth ounce should be allowed for each inch increase in tree diameter. The dry iron salt should be packed in and covered over with grafting wax. The salt dissolves and is taken up to the leaves by streams of rising sap. Soluble iron sulphate may also be used but it is less economical.

Trees should be treated in the dormant season to avoid danger of injury to foliage and fruit. In no case should ferric ammonium citrate be used. Its ammonia is injurious. Moreover, this salt is not an economical source of iron for tree use. The practice of driving common nails into the tree is almost useless.

The most desirable method of control is to select, or develop by plant breeding, rootstocks that tolerate alkaline soils. Because sand cherries are notorious for chlorosis trouble, it is wise to graft them on plum roots. The Americana plums from the prairies are preferable to the Canada plum (*Prunus nigra*), which is the one found in the more acid soils of the north and east. Therefore, the chlorosis problem may be partially solved by careful selection of rootstocks to be used in the high-lime orchard.

Livability of Fruit Trees

A prairie orchard with favorable shelter, soil, exposure, establishment, and maintenance, may be expected to remain satisfactorily productive for at least a score of years. Apple and crabapple trees have fruited well in southern Manitoba when over 40 years of age. However, local conditions—featured by extremes of temperature in both summer and winter, dry air, scanty rainfall, and considerable winds—are trying. Trees will likely be weakened to the point that they should be replaced at about the following ages: crabapples, 20 to 30 years; apples, 20; pears, 20; plums, 15 to 25; apricots, 12 to 20; cherry-plums, 10 to 15; sour cherries, 8 to 20, and Manchu or Nanking cherries, 10 to 12 years. In an orchard set in an unfavorable situation trees will break down in vigor in early and mid-life, and frequent replacements will probably be needed.

It is a good policy to set out two or three additional trees of each type of fruit every five years. Then, if untimely and killing frosts such as the September freeze of 1942, or the springtime deep freeze of May 1946 occur, there will be a variation in the ages of the trees and a substantial part of the orchard should be in a stage of development that will withstand the shock of abnormally adverse weather. Trees recently planted and old trees that have been weakened by heavy cropping are considered prone to greatest injury from untimely freezes.

In all cases it is very important that only those varieties possessing sufficient winter hardiness should be planted. Tender varieties cannot withstand the rigors of severe long winters. If the plan of setting only adapted hardy varieties, and making successive periodic plantings is practised, the home orchard should prove a continued satisfaction.

Why Orchard Trees Fail To Fruit

Sooner or later every thrifty fruit tree is expected to come into bloom. A seedling sand cherry may blossom in its second year while a seedling apple or pear may not put forth flowers for twelve or fifteen years. On occasion, trees may flower profusely but not produce fruits. There may be one or more of a dozen causes of this failure.

Frost during or following blossoming is a common explanation in the clear-aired prairie country. The style and stigma of the pistil are sensitive to light frost. They may be injured even though the eye does not detect the damage. Heavier frost may destroy the pollen. Slightly frosted blossoms may produce fruit but the skin of such fruit may be russeted at the calyx end and contain few seeds. To escape fruit loss through frozen blossoms, late-blooming varieties should be chosen and planted on northern or eastern slopes.

Ineffective Pollination probably accounts for a large proportion of failures. Many hardy tree fruits are self-sterile. They require pollen not only from another tree but from a tree that is of a different variety. All our hardy plums are in this category. Included are native, Japanese, and cherry-plums. In the many trials at the Dominion Experimental Station, Morden, the one exception has been the hybrid, Kaga. On three different occasions potted Kaga trees have set light crops to their own pollen. Some apples, apricots, pears, and sour cherries are fairly self-fruitful. However, it is approved policy to treat them all as if they were self-unfruitful and provide neighboring kindred trees of different varieties that blossom at the same time for the purpose of effecting successful cross-pollination. The timing of full bloom is vital. The blossom periods of the cross-pollinizing varieties must overlap. The individual blossoms remain receptive to effective pollination for 2, 3 or 4 days only. Insects, particularly honeybees and wild bees, are essential because fruits are insect-pollinized. Tree fruits will not develop in the absence of agents to bring pollen grains to the stigmas.

Impotent Pollen is typical of a number of fruits. Triploid apples (those having 1½ times the normal number of chromosomes) such as Hibernal and Virginia crabapple are of little, if any, use as pollinizers. Many hybrid plums have non-viable or weak pollen. Examples are Red Wing, Underwood, Radisson, La Crescent, Fiebing, and Manor. The grower is obliged to select a range of varieties with viable pollen sufficient to accommodate all fruit trees. For example, with a combination of La Crescent and Bounty plums, an additional variety with virile pollen congenial to Bounty is required as La Crescent pollen is impotent. Therefore, another tree, such as Norther, must be added to the group. Then there will be two kinds of potent pollen for La Crescent, and one for each of the other two.

Cool Weather may prevent bee flight, restrain pollen germination, and slow up pollen-tube growth. Temperatures should be considerably above 40 degrees F. and preferably 60 degrees or higher. *Wind* may deter bees, or may dry up that sugary substance, the stigmatic fluid, upon which the pollen grains germinate, and it may injure the flowers by whipping the branches about. *Rain,* if prolonged, may discourage bee flight until the critical time for fruitful pollination has passed. *Lack of Food* supply may result in failure of the fruit crop. When the food supply is insufficient the little fruits may degenerate and finally drop off. Such trees may benefit from an early spring application of a nitrogen fertilizer accompanied by an ample supply of water. *Disease,* such as fireblight and brown rot, may cut down the crop by attacking the flowers and young fruits. The former attacks apples and pears, the latter, plums and cherries.

The orchard where suitable pollinizers are lacking may be cross-pollinated by *temporary methods.* The simplest way is to bring a bouquet of blossoms of a desirable variety from another orchard. Branches of fair size should be used because they keep their flowers in condition better than do thin branchlets. The stems of the flower branches should be immersed in water in a flaring pail and the bouquet placed between the fruit trees, preferably on a box or other support where the bees can conveniently work them. In the bouquet some flower buds

should be open and some about to open. An alternative temporary expedient is to employ hand pollination. The flowers of the required other variety should be gathered; the anthers rubbed off by scratching the flowers across wire fly-screen of small mesh, and the pollen placed on shiny paper in a still, sunny room to ripen. The next day the collected pollen grains should be placed in a small bottle and applied with a fine-haired lettering brush to the stigmas of a representative number of flowers distributed about the tree needing cross-pollination.

Top-working a few branches of bearing trees with scions of a pollinator variety is a speedy method of providing for cross-pollination. Top-worked in early May, the scions should produce flowers the following spring.

Fig. 10. Waneta, a large dessert plum, bearing heavily the year after scions were grafted on branches of a small-fruited wild plum.

Bees and Fruit Pollination

Fruit trees may be covered with blossoms in May but may not produce any fruit. Their pollen is moist and is seldom, if ever, dispersed by winds. This is in marked contrast to corn, grasses, and many trees which are habitually pollinated by light winds. Fruit pollen is transported from flower to flower by honeybees, bumblebees, and a few other spring insects. Native insects are seldom present in large numbers in the early season. As there is a very great deal of work to be done in a short time when orchard trees are in bloom, it is good orchard practice to have colonies of honeybees comfortably hived in or near the orchard by early May. Honeybees are wintered over in the hives, or else new packets of bees are imported and hived by the first week of May. Then tens of thousands of bees go on the hunt for fruit pollen to feed their young brood. Much of the pollen adheres to the hairs on their bodies and legs and this is deposited on the stigmas of the various flowers visited.

Bees like warm calm days. When temperatures are under 50 degrees and winds are over 20 miles per hour, bees tend to remain inactive. Satisfactory results in cross-pollination may be expected in a well-sheltered orchard when the bee population averages one colony per acre.

Winter Hardiness

The first requirement of a fruit tree for the prairie orchard is that it be able to withstand prolonged low winter temperatures. Fortunately, several species in a number of the types of deciduous orchard fruits possess winter hardiness in abundance. In apples there are the Siberian and Manchurian crabapples; in pears, the Ussurian; in plums, the natives and some from the Northern Orient; in cherries, the natives and several types from Asia; and in apricots, the Siberian and Manchurian.

A plant that is winter-hardy usually ripens up its wood well in summer and early autumn and enters a deep or profound dormancy in autumn. The hardy tree has the ability to retain much of its cell water as "bound" water with little in the form of "free" water. This faculty appears to be associated with heavy storage of carbohydrates and with colloidal substances in the sap that have a powerful affinity for water. It is obviously important that all trees be kept in good health and free of insect and disease pests so that they enter winter well nourished.

Tender varieties break their dormancy easily. In fruit breeding in the local greenhouse it is customary to bring in Assiniboine, Bounty, and other select native plums about two or three weeks before La Crescent and Superior are moved in. The latter two varieties break their dormancy much sooner. Tender varieties are relatively sensitive to changes in temperature. The aim is to have the various trees bloom on the same dates for purposes of cross-pollination.

Winter Injury

Injury and death of plants from freezing is explained in several ways. Upon freezing, water is withdrawn from the cells and ice forms in the spaces between cells. As the cold intensifies, these crystals enlarge by more water being withdrawn through the cell walls. The resulting pressure may become sufficient to disrupt the cell walls by pushing them inwards. If the temperature rises before death occurs, the ice crystals melt and the water re-enters the cell and is absorbed by the protoplasm. On the other hand, if freezing temperatures persist, the plant in a sappy condition is likely to be killed by freezing.

One theory of death by freezing in actively growing plants is that the withdrawal of water increases the acidity of the sap to such a degree that the protein materials in the protoplasm coagulate. When this stage is reached the plants are not capable of regaining their normal character. Succulent tissues may be killed by excessive loss of water, which means sheer drying out. The gradual change of woody plants from their tender condition of midsummer to their hardy state of dormancy in early winter is considered to be largely one of the water-retaining capacity of the protoplasm or cell-sap.

Killing of Dormant Buds:—Flower buds are usually more tender than leaf buds. Tokata plum may lose many or all of its flower buds but the leaf buds may be uninjured and open normally in May. The plan of bending down low branches of fruiting trees in late October and mooring them to the ground, or mulching them with soil, may result in their buds wintering successfully while those on the top branches are injured or killed. In the Chinook belt of the southwest prairies, trees may lose the flower buds by premature swelling in response to spells of warm weather in late winter. In the Lethbridge district, plums and other stone fruits are liable to such losses. Apples are less susceptible. It is good policy in such localities to limit planting to those strains that retain dormancy until spring. Mulching manure on frozen soil to delay the date of fruit blooming by keeping the soil over the roots frozen is not effective.

Killing-back of the ends of branches is common in trees too tender for the region. Young trees may tip-kill because of their failure to stop growing and finally ripen their wood before the advent of autumn frosts. Cultural practices that induce early formation of terminal buds should be followed. Cultivation should stop in mid-July; and heavy irrigations in August and early September should be avoided.

Black heart is the condition arising where newly-formed wood, injured by frosts, takes on a water-logged appearance and later darkens. Growth the following year is usually meagre. However, if the cambium has remained sound, the tree may recover and be useful for a number of years. The chief hazard from black heart is the ease with which rot organisms grow in the discolored wood after they have gained entrance through a pruning wound or broken twig. All wounds should be given a protective covering promptly.

Bark splitting near the ground is common on succulent young trees when there is a sudden low dip in temperature in autumn. Sometimes the bark loosens. When this happens the bark should be fastened with large-headed tacks. Encouraging early ripening of trees in summer helps to avoid bark injury.

Trunk splitting may occur in winter where the medullary ray portion of the trunk contracts more than the other wood of the tree during an abrupt hard freeze. Early ripened trees should escape this trouble.

Collar injury:—The collar or crown of the tree, that portion of the trunk immediately above and below the soil surface, is later in ripening up than is the upper trunk. An early onset of winter may kill the cambium. To escape this calamity it is prudent to topwork semi-tender varieties on the framework of other varieties that are hardy and possess a durable trunk. A tree girdled by crown injury can be saved by inarching two or more newly planted seedlings into its green trunk in early spring.

Crotch injury:—The wood in the tree crotches seems to be late in ripening, as is that of the crown. If killing occurs, rot is likely to develop and the tree is soon lost. Double-working on varieties having broad U-shaped rather than V-shaped crotches, coupled with careful pruning to avoid double leaders, are means of prevention.

Sunscald:—The killing of bark on the southwest side of tree trunks and main branches is widespread in prairie plantings. It occurs in late winter and early spring. The sap is stimulated by the direct rays of the strengthening sun on clear days. When frosty nights follow and bark killing results, it is sunscald. It may be prevented by double-working on sturdy stocks, low-heading of trees to induce substantial branches low on the southwest side, inclining the tree into the southwest on planting to avoid the direct rays, and screening the endangered portions of trunk and main branches with boards, white building paper, sacking, corn stalks, or even with a durable painting of heavy whitewash.

Root-Killing is caused when severe frosts penetrate into the roots. Alternate freezing and thawing may be destructive to roots. The leaf buds of a fruit tree that is root-killed usually open in the spring, but when the leaves are only partially grown they pause, dry up, and die through lack of soil moisture. Dry soil permits rapid escape of soil heat, and this, in the absence of snow, exposes roots to undue freezing. As a precaution, only the very

hardy fruit seedlings should be used as understocks, the soil should be irrigated in mid-October, and a ground cover of manure or other litter applied to blanket the soil over the root zone. In this case a cover crop has the advantage in that its leaves and stems act as a surface insulator.

FIG. 11. Boards tacked to the trunk and main branches of an apple tree to prevent sunscald.

There have been two disastrous abnormal freezes in prairie orchards in recent years. These are without known precedent. In September, 1942, trees were growing actively when abrupt freezes, starting on the 25th, occurred on four successive nights. The low was the night of the 28th with a temperature of 19·5 degrees. Little could be done in that unusual situation. The trees were not yet advanced in the hardening process. The cambium was injured and in some cases injured so severely that these trees were doomed. Trees only moderately injured were heavily top-pruned the following spring to aid recovery.

The second calamitous freeze was the second week of May, 1946. The season was two weeks in advance of the average. Apples were in full bloom on May 9 when the first of four successive night frosts came. A minimum of 12 degrees F. was recorded on the early morning of May 12. Most of the apple, pear, and apricot crops were destroyed for that year and the harvest on many plums and cherries was severely curtailed.

These two unseasonable freezes are mentioned to emphasize the wisdom of setting out a few more young trees every five years or so.

Hastening Fruiting

The life purpose of fruit trees is to blossom, set fruit, develop seed and thus perpetuate the species. Every normal healthy seedling or grafted tree may be expected, sooner or later, to reach blossoming. Some, like the sand cherry and its hybrids, do so early; others are tardy, and such are found occasionally among pears and apples. The grower may resort to more or less drastic action to hasten the flowering process.

The aim is to balance the carbohydrate-nitrogen ratio in the tree. Flower-bud formation requires a relationship in which there is a moderate amount of nitrogen with a moderate (to higher) amount of carbohydrates. This makes for fair vigor of vegetative growth associated with the storage of a large amount of starches and sugars, or carbohydrates, within the plant. It is essential to have a good crop of healthy leaves to elaborate plant food. This means freedom from defoliating insects and diseases. Heavy pruning that results in over-stimulation of new vegetative shoots should be avoided, but pruning should allow sunlight to shine into the tree. Shade that cuts down direct sunshine should be removed, and the tree should be kept in a medium vigorous growth condition by regulating the supply of moisture and fertilizer.

Most of the flower buds are differentiated from leaf buds by the end of June. To become flower buds, instead of merely leaf buds, there must be an accumulation of starches in the spur, or in the tissues behind the bud, at that time.

Root Pruning may be done to reduce the intake of mineral nutrients for the purpose of slowing up vegetative growth. A trench should be dug around one side of the tree at a distance of two or three feet, and to a depth of about two feet. The plant continues to possess its full complement of leaves to manufacture starches while the intake of stimulating soil nutrients has been curtailed. The results are not altogether certain, but theoretically the operation is sound.

Girdling or *ringing* a scaffold limb is done to prevent movement of food down past the cut. A strip of bark about one-quarter inch wide should be removed from around the branch down to the cambium layer or outer rim of wood. A handy tool for the ringing may be made by fixing two safety razor blades parallel, one-quarter inch apart, in a block of wood. The practice must not be overdone or the roots will become starved for carbohydrate food. The girdled area forms callus and grows over, usually in a year's time. As the operation devitalizes the tree, not more than two out of six main scaffold branches should be girdled in one season. Girdling should be done when the main flush of growth wanes in early June. Concentration of food above the cut should then be in time to effect flower bud differentiation in some of the buds that would otherwise remain only leaf buds.

Bending Branches to a horizontal position, and tying them to stakes or to the trunk with rope or burlap, is essentially a girdling. The bending restricts cell growth on the lower side and stretches the other side of the branch. This disrupts cells on two sides of the limb. In addition more direct sunshine reaches the branch, favoring greater photosynthesis and flower bud formation.

Thinning Fruit

Thinning off surplus fruit encourages fruit of high quality to develop and at the same time eases the stress of seed and fruit production on the trees. Producing fruit is an exhausting process. If an overload of fruits set, the tree will be devitalized; the numerous fruits will be small in size and inferior in both flesh and flavor.

Thinning maintains the vigor of the tree; increases the size and flavor of the remaining fruit; results in a higher percentage of first-grade fruit even though the total bulk is somewhat less; removes injured, mis-shapen, frost-ringed, and pest-infected fruits; improves skin color because sunlight is distributed better; eases the weight on branches and thus reduces breakage; encourages cropping the following year by avoiding over-taxing the resources of the plant, and secures superior fruit specimens to exhibit at the local fruit shows.

Varieties requiring thinning because of a tendency to overbear include Haralson, Breakey, and Godfrey apples; Florence, Dolgo and Trail crabapples; Ojibwa, Mina, Dandy, and Norther plums; Sapa and Dura cherry-plums, and Scout apricot.

Thinning should be done with the thumb and first or second finger. The other fingers may help in protecting the fruit that is to be retained on the spur or in the cluster, or in pushing off fruits to be discarded. A sideway pressure should be exerted on the stem of the fruit to be eliminated. A forward pull might dislodge the spur or the fruit that is to be left. At times thin shears can be employed to advantage, particularly if the variety has short stems. Thinning should be done in late June or early July, following the natural June drop—four to five weeks after full bloom of the tree. August thinning is too late to accomplish any significant benefit.

The amount of thinning varies with the variety and type of the tree. Some growers aim to leave one apple to each 20 or 30 leaves on the fruiting branch. Another practice is to leave only one fruit to a fruit spur or cluster. General suggestions are to leave one fruit for the following lengths of branches:—apple, 5 to 8 inches; crabapple, 1 to 2 inches; plums and apricots, 2 to 3 inches, and cherry-plum, 1 to 2 inches.

Harvesting

Fruits are perishable and should be handled as gently as eggs. Bruises are unsightly and encourage rot. The approved method of picking apples, pears, and some other fruits is with a slight upward twist. The fruit spur should remain unharmed, and the stem should be left on the fruit. This is in the interests of keeping quality as well as appearance.

Stage of Ripeness is an important consideration. As a rule, ripening processes develop best on the tree. A notable exception is the pear, which is best picked when size is attained but before it is fully ripe and while the flesh is still firm. Pears should be allowed to become prime in a storage with a temperature of 60° F. In marked contrast, grapes must be left on the vine until mellow for they do not seem to change in quality after picking.

The apple takes on several indications of ripeness. The first is the change in ground color, or under color, from dark green to light green or from greenish yellow to amber. The over color means little or nothing as an index of ripeness. An apple may be red all over long before it is ready for picking. The coloring of seeds from green to brown is sometimes a guide but the seeds of some varieties begin to brown weeks before they are sized up. When the stem is readily severed from its spur the fruit should be picked. As soon as fruits begin to fall without the stimulus of winds or other agencies the crop should be harvested at once. Some varieties ripen unevenly and so require spot picking. The apples that show faded ground color should be removed. The fruit should be twisted across the thumb or with a gentle upward motion, taking care not to bruise the ripe cells under the tender skin. Some varieties bruise easily. The fruit should be placed carefully in the basket or bucket lined or at least floored with canvas or coarse cloth.

Plums of native type, and a cherry-plum like Opata, which become very juicy when soft, should be gathered when hard ripe. Experience will teach the time to harvest. Indications of readiness are a waxy bloom on the skin, characteristic coloring, a springy softness of the flesh when the fruit is gently pressed, and in some cases, the aroma. For dessert use, only ripe fruits should be taken. This may involve as many as four pickings. For canning purposes the whole tree is usually stripped at one harvesting as highest quality is not so requisite. Placing a sheet of burlap under the tree and shaking off the fruit is not good for the plums but makes for quick work.

Cherries are easily picked. The time can be decided by touch or by tasting.

Apricots are picked in much the same way as plums. Changing color indicates readiness. Two or three pickings may be required to obtain quality in fruits borne on the inner parts of the tree. All fruits should be promptly placed in shade and shelter at picking time and removed to the cooling room as soon as possible. Equipment for harvesting fruit includes baskets, a step-ladder, and leaning ladders. A handy contrivance may be made by nailing a short plank on an ordinary carpenter's horse, and running the unsupported end into a strong tree crotch. The picker works from the plank.

Fig. 12. Scout apricot being picked at Morden.

Storage of Fruit

A fruit is a living thing. Changes in the physical and chemical composition take place within the fruit until the volatile or essential oils, which impart flavor, have departed, and the tissues have broken down to that condition which takes it past the eating stage. The task in successful storage is to supply an environment that will retain the fruit in prime eating state for a maximum period of time. The chief factors involved in storage are temperature and humidity. Ventilation is also a consideration.

Temperature control is of first importance. Warmth stimulates the vital processes causing the fruit to live faster. Investigators calculate that apples ripen about twice as rapidly at 40° F. as they do at 32° F.; nearly twice as fast at 50° as at 40° F., and approximately twice as quickly at 65° as at 50° F. Thus a variety that reaches prime eating condition at 65° F. in one month from the time it was picked would take about two months storage at 50°, and four months at 40° F. There is a small variation in optimum storage temperatures for different varieties of apples but for most it appears to be 32° to 34° F.

Humidity is a second very important factor. Unless the air in the storage chamber is relatively moist, fruits will lose weight by evaporation and shrivelling will result. The relative humidity in the storage room should not be lower than 80 per cent. Rapidly moving air currents in a room of only moderate humidity quickly cause loss of fruit moisture. There are several common means of increasing the moisture content of the storage atmosphere. These include flooding the floor with water, using an electric humidifier, running a fan to circulate the air over melting ice, and opening the ventilators when the air outside is humid.

Ventilation is valuable in air-cooled cellar storages in that it is a factor in controlling temperatures. Ventilators are opened during the cool of the night and closed in early morning. Storages that are mechanically refrigerated do not require ventilation. In the latter type the plan may call for a concentration of carbon dioxide gas so that life processes of the fruit are slowed up by slackening the rate of respiration. Persons interested in this recent development of gas storage are directed to special bulletins on modern storage of fruits. These publications contain information on different types of storages with details on their construction and operation.

It is important that fruit be taken out of the sun, wind, and heat into a basement or cool room promptly after harvest. Where large quantities of warm fruit are coming into the reception room, fans should be operated to effect rapid chilling. Using blocks of ice in these pre-cooling rooms is an advantage. Not only does ice absorb much heat in melting but it contributes desired moisture to the air.

Propagation

Fruit varieties may be increased by vegetative means. A piece of the mother parent may be used to secure a new plant that will be essentially identical to the original. Therefore, the fruit grower has a significant advantage over crop growers who must depend upon seeds for increase. Most growers buy their fruit plants from nurserymen, but some may wish to raise their own. Comprehensive treatment of the subject may be found in special bulletins, charts and books. For convenience, general information is given in this section.

The stock is that portion of the plant into which grafting is done. Usually it is obtained by growing from seed. Experience has shown that certain species are more satisfactory than others as stocks for a particular class of fruits. Apples may be grafted on pears, mountainash, saskatoon, cotoneaster, hawthorn, and various apple species. However, hardy crabapple seedlings are preferred. Union with less loosely related plants, such as hawthorn, is likely to be weak, and the plant is usually unthrifty and short-lived. Congenial stocks form a smooth graft union. On the other hand, the development of a large knuckle at the point of union indicates a lack of congeniality.

At Morden hardy healthy crabapple seed is used. Columbia and Bedford are first choices. Others that give an even stand of vigorous seedlings are Osman, Anaros, Beauty, Dolgo, and Florence. Siberian crabapple seedlings are chosen by some but their wood is hard to work, and the roots are often shallow and tend to make a dwarfed tree. Manchurian crabapple is deeper rooting but the upper wood may be brittle.

Treatment of the seed: Good results are usual when seed is extracted from the fruit, placed in damp sand in a cool basement until late October, and then planted outdoors in a seedframe in moist soil. If a sprinkling of sand and a spread of acid peat is made in the bottom of the trench before seed is sown, the seedlings next spring may be healthier.

An even more dependable procedure is to sow the fresh seed in flats with a ½-inch covering of sharp sand. The flats should be placed in below-freezing storage until mid-January, then stored in a chamber of 41° F. for 2½ months. They should be removed to the greenhouse April 1, and in late May placed in a cold frame. The following spring the seedlings should be transplanted to the nursery row.

A third method is to store the seed dry until late January, then stratify in moist sand, place in a cool basement until April when the seed should be sown in a coldframe or seedbed. If sprouting begins in early April, the container should be removed to cold storage until outdoor conditions are favorable for sowing.

"After-ripening" refers to the changes in chemical or physiological condition that must occur in the dormant embryos of seed of some plant families before germination can take place. Seeds of the rose family are good examples. To accomplish after-ripening in apples, the seeds require from 2 to 3 months storage in a moist medium at temperatures about 9 degrees above freezing, or 41° F. Plum seeds require a period of 3½ to 5 months.

One pound contains approximately the following numbers of seeds:— Siberian crabapple, 45,000 to 77,000; hardy crabapple, about 12,000; Ussurian pear, about 15,000; Canada plum, 650 to 750; American plum, 800; sand cherry, 1,500 to 2,200; apricot, 260 to 450; black walnut, 32 to 48; hawthorn, 7,800 to 16,500; buffaloberry, 30,000 to 40,000; American elder, 175,000; and Russian mulberry, 250,000 to 350,000 seeds.

Pears are usually grafted on seedlings of such hardy oriental pears as the Ussurian. Experience indicates that seedlings of hardy hybrids, such as Tait-Dropmore, may be more fully satisfactory than the Ussurian. Seed treatment is the same as for apples.

Plums should be worked on *Americana* seedlings. The Canada plum is acceptable but the wood is hard. Sand cherry seedlings are dwarfing and adapted only for small-growing varieties such as Manor and Sapa cherry-plums. Large plums budded on sand cherry tend to blow over and be short-lived. Japanese plum seedlings promise usefulness. Choke cherry stocks will unite with plum scions but their use is considered novel rather than practical.

Seed should be removed, washed, and placed in moist sand before drying occurs, for if the pits dry out they may not germinate for two or three years. There are several methods of treatment. (1) They may be stored in a cool cellar until early November when the seed should be sown about 1½ inches deep in trenches outdoors, preferably in a seedbed with board sides and a movable lattice top. They should be watered thoroughly. After the ground freezes, and the mice are thus prevented from digging, a length of board, or a mulch of moss, straw or manure should be spread over the rows. In late April the mulch should be removed and the soil covered with a ½-inch layer of sand. The sand tends to prevent a crust from forming on the surface and to reduce the danger of damping-off disease. (2) In late summer the seed or pits (as soon as they are washed) may be sown in trenches that are well wetted before being filled in. (3) The most favorable treatment seems to be to wash the pits, stratify them in a can or flat between layers of moist sand, and place in frozen storage. Early in January the container should be moved to cellar storage at about 41° F

In late April the seed should be sown in a seedbed or coldframe. If germination threatens to begin before the soil is ready for sowing, growth may be delayed by returning the container of seeds to frozen storage. Lacking an inside cold storage, the seeds may be placed in an earthen pit at the north side of a hedge or building to restrain germination.

Cherry seed should be treated in the same manner as plum seed. Some cherry seed, as *Prunus fruticosa,* may do well when stored dry, that is, it does not need storage in moist stratification pending sowing. However, good husbandry is important to all seed.

Apricot seeds should receive the same care as plum seed.

If there is any danger from mice, seed containers should be protected by covering with wire fly screen. Autumn-seeded material may be protected from mice with poisoned bait until the soil becomes frozen.

Grafting

Grafting is done to perpetuate, or increase, a desired fruit selection. A piece of the actual wood of the variety, the scion, may be inserted into a suitable root or stem, the stock. Although the stock and scion portions enter into full partnership in future growth, the branches and fruits arising from the scion will remain identical to those of the tree from which they came. Grafting is employed also to add branches of a second variety to serve as a pollinator on a lone tree. The operation, known as "double-working", involves a middle variety being used to build a sturdy framework on a durable seedling root. This ensures a foundation of strong durable branches for fruiting portions of the tree. Another use of grafting is to repair damaged trees that have been girdled by mice, rabbits or careless cultivation. This is "bridge grafting". Girdled trees may also be saved by "inarching", that is, the top portion of a young seedling tree that has been planted close to the injured tree may be grafted into the live bark above the girdle wound.

Scion wood is cut generally in late November and December. It should be taken from well-grown terminal shoots of that year's growth. Second-year wood is used only in the absence of sufficient one-year shoots. The preferred size is about the diameter of a lead pencil. The best scions come from the central portion of the stout shoots where buds are best developed.

It is vitally important that scions be kept completely dormant. If the buds have become swollen, the chances of success are slim. Storage for root-grafting in January or February should be in damp sand, peat moss or sawdust, and at from 32° to 40° F. If scions are intended for topworking next May, they may be buried outdoors in a box of damp sand at a depth of $1\frac{1}{2}$ to 2 feet on the north side of a building or dense hedge. The spot should be well covered with strawy manure to form insulation. An ice-house or refrigerator offers suitable storage for short periods. Scion wood when taken to the field for working should be kept in good condition by wrapping in damp burlap.

Root-grafting is illustrated in Fig. 13, sketch B. The whip-and-tongue method is shown. As in all graftage, success rests on the precise contact of the cambium layer of the scion with that of the stock. The cambium area is the place of cell-division and growth and is a narrow layer on the inner bark and outer wood. The diameters of stock and scion should be approximately the same. However, cambium contact will usually be at one side only. The two tongues should interlock. The union should be made firm by winding with waxed cotton thread. The grafted material should then be packed in a box of damp moss and placed in a cool basement until planting time. Root-grafting is popular for apples and pears. Stone fruits are usually budded for a maximum catch.

Budding, or bud-grafting, normally should be done in July and August while the bark of the stock still slips readily from its wood. Instead of a piece of branch carrying several buds, the scion piece is merely a detached bud surrounded by bark. It appears to matter little if a moderate quantity of wood remains attached behind the bud. The "bud-stick", or piece of wood from which the buds are obtained, should be of the current season's growth. Only the plump, well-developed middle buds should be used. These are removed by inserting the knife a half-inch below the bud, making an upward sweeping cut behind it and out half an inch above, that is, from below upward. Previously the blades of the leaves should be cut off leaving about half an inch of the petiole as a "handle" for ease in inserting. The hands of the operator should not come in contact with the cut surfaces of the bud. Shield or T budding is the method commonly adopted. A T-shaped incision should be made low down on the north side of the seedling, the bud neatly slipped in, then given snug contact by wrapping the bud and stock with raffia which is carried in a pail of water. Recently rubber budding strip has been replacing raffia. The binder should be criss-crossed to bind the cut surfaces yet leave the bud exposed. (Fig. 13, A) Bud-sticks may be kept fresh in wet burlap wrapping. All hardy tree fruits may be increased by budding.

Double Working

Double working is the building of the main trunk of an intermediate variety. The purpose is to have the central portion of the tree formed of hardy robust wood resistant to sunscald, crotch weakness, and crown injury. On its side branches the variety to be fruited is worked. In southern Manitoba vigorous healthy crabapples, with wide U-shaped rather than V-shaped crotches are chosen for apples. Among the esteemed varieties are Columbia, Bedford, Anaros, Beauty, Olga, and Garnet.

The methods of working these intermediate stocks may be by cleft grafting, bark grafting, stub, and oblique side grafting. Dr. R. J. Hilton, Professor of Horticulture, University of Alberta, discusses the subject as follows:

"Frameworking: This method is becoming increasingly popular in areas where cold winters make the use of very hardy tree frameworks necessary.

"Briefly, this practice, known as framework-grafting, involves using the existing frame of the tree, removing the young shoots, badly placed branches and spurs. On this cleared or 'pollarded' frame, scions of the desired variety are grafted by one of several simple methods.

"The two most easily and effectively used under Alberta conditions are known as 'side' and 'stub'. Side grafting simply means a cut through the cambium and well into the wood, and the sliding of a scion firmly into this cut. This is done in such a way that the cambium at the basal cut of the scion crosses that of the stock at one or more points. This graft can be made at any desired location on the branch, whether it be the lateral or main, so it is a very useful type. (See Fig. 13, C and D, c and d for details.)

"Stub grafts utilize the basal part of a small side branch (a 'lateral') or a spur, and to apply this method a cut is first made into the wood of the branch, just above where it joins the larger one. This cut is rather slanting, and no more than half-way through the branch, and the scion (with a 'double-wedge' cut at the base) is forced into the cut. A convenient way to do this is to use the outer part of the stock branch as a handle to open the cut, allowing it to spring back when the scion is placed therein. Obviously, this method can be used only where small side branches occur upon the tree. (Fig. 13, D, a, illustrates this method.)

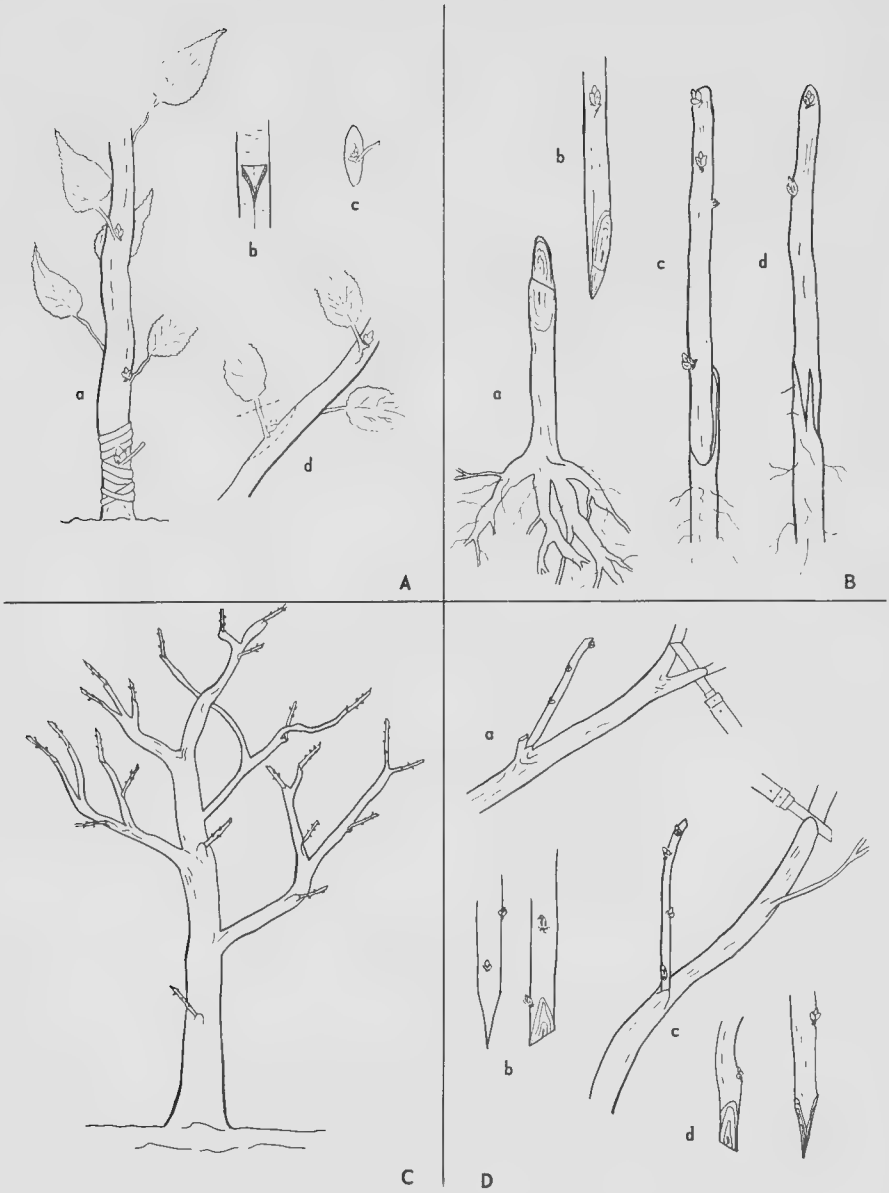

FIG. 13. Grafting methods: A. (*a*) Budding—bud inserted in young rootstock tree and tied in place with rubber band. (*b*) Showing "T" cut in stock bark, in which bud (*c*) is inserted. Dotted lines at (*d*) show how bud is cut from budstick. B. Showing detail of stock and scion cuts for "whip-and-tongue" graft method. C. Showing young stock tree frameworked with 23 scions of a desired variety. D. Two frameworking methods: (*a*) "stub" graft, (*b*) detail of scion basal cut for stub graft, (*c*) "side" graft, (*d*) detail of scion basal cut for side graft.

"Time to Graft: Stub and side grafting, whether used on the cut-off butt of a stock, or on the stock framework, is done in spring. Plums and cherries should be grafted only when they are dormant, which means not later than early May, but apples and pears can be grafted successfully from late March until mid-June, given reasonably good growing conditions.

"Protecting the Grafts: Grafting done out-of-doors in spring needs protection at the unions and at the cut-off upper tip of the scion. For this purpose many types of wax are used. If one does not wish to make up the material, grafting wax may be purchased from almost any seed company or retail seed store. Among several formulae for making wax at home, the following two will prove satisfactory:

No. 1. A 'hand wax' to be applied by hand, rendered soft enough for that purpose by kneading with the hands.

Resin	4 lb.
Beeswax	2 lb.
Raw oil or tallow	1 lb.

melt together and stir, then pour into a pail of cold water and pull like molasses candy.

FIG. 14 Solving a problem by double-working. Yuksa (sand cherry × apricot) is budded congenially on a plum root; the commercial apricot is budded on the Yuksa trunk. Plums are more tolerant to heavy soils and moist conditions. Yuksa as the intermediate stock makes for a strong tree, whereas the union of apricot on plum is weak and of short duration

No. 2. A 'brush' or 'hot' wax to be applied with a brush. (Is warmed over a small fire such as a gasoline burner.)

Resin	6 lb. 10 oz.
Tallow	1 lb.
Paraffin wax	1 lb. 4 oz.
Venetian red powder	1 lb. 8 oz.

Melt resin and paraffin together, then put in tallow and remove from the fire. After this has melted, stir in Venetian red powder and pour the mass into cold water, treating it as for formula No. 1.

"Waxing must be thorough. If air-holes tend to form as the wax cools, then a review of the job a day or so after the first waxing will prove of value. Cut surfaces and graft unions should not be left unwaxed for more than an hour or so after the grafting is done. It is a good plan to wax any wounds larger than one inch in diameter at the same time as the grafts are waxed. Waxing over scion buds does not stop their normal development if the graft union is good."

Layering

Although most orchard fruit trees do not grow readily from hardwood or greenwood cuttings, their number may be increased by layering. A farmer a few miles south of Morden has a 2-acre orchard of apple and plum trees, all of which he grew from layers made on a small collection of trees in his cottage garden.

Layering is simply bending a low branch to the ground, pinning it in place, and covering the middle portion with a few inches of fertile loamy soil while leaving the tip protruding. It may facilitate rooting if a sloping cut is made at the base of a lower bud on the covered portion. The soil covering the branch should be kept moist. When rooted, the branch tip should be cut off and dug up to form a new plant.

Another farmer in southern Manitoba with a thrifty 3-acre orchard is unusually successful in his propagation. One of his original ideas is his method of preparing the stock for grafting. He makes a rubber funnel from the inner tube of an automobile. This he fastens on the branch or trunk to be grafted, a few inches below the union. Then he drops a handful of earth into the rubber and moistens it from time to time. The claim is that the moist earth in contact with the bark maintains the stock in mellow condition.

Pests

Fruit trees, like all other living things, are subject to injury from enemies. Disease, insects, and animals—particularly rodents—may attack orchard trees and injure them severely. Fortunately, diseases in prairie orchards have been few. As plantations become more numerous, fungus and bacterial maladies likely will be more prevalent. Insect invasions come in varying intensity from year to year, the degree being somewhat linked with weather. Rodents—mice, rabbits, and pocket gophers—may be few or numerous. Grassy areas favor the presence of mice. The grower must be prepared to combat these gnawing animals at all times. A rabbit or mouse can cause grievous destruction to a tree in one hour.

Spraying is the usual means of protecting the fruit trees against insects and diseases, but poison sprays should be applied only when insect enemies or disease organisms are present. Special bulletins, circulars, and spray calendars are available that describe individual pests and prescribe treatment in detail. Discussion here is of a general nature. Recently many new chemical poisons have been developed. Among such are DDT, mineral oils (summer and dormant grades), chlordane, toxaphene, parathion, fermate (ferric dimethyl dithiocarbamate), and wettable sulphur. Fruit growers are directed to their horticultural advisors for local recommendations, and a copy of the latest spray calendar.

Old-time reliable sprays have depended upon four poisons—lime-sulphur, bordeaux mixture, lead arsenate, and nicotine sulphate. They remain adequate for the common pests likely to infect local plantations; and hardware and drug stores carry them in stock. A small hand sprayer is satisfactory for the home garden. A one-acre orchard may be handled by a barrel pump sprayer. A power sprayer is needed for large plantings. After each day's work the nozzle, hose and sprayer tank should be washed out to avoid corrosion of the metal parts.

Poisoning may be done by dusting instead of spraying. In treating trees against pests in this country of dry air and considerable wind, spraying is the more satisfactory method. Spraying takes less poison to do a thorough job; dusting involves less labor.

Dormant Lime-Sulphur Spray

Water	35 gallons	(Imperial)	1 gallon
Lime-sulphur, powdered	20 lb.		½ pound

This spray should be applied when the buds begin to show green tips. It is used to combat scale insects, red spider mites, scab, plum pocket, black knot, leaf spot, and other diseases.

Arsenate of Lead and Lime-Sulphur Spray

Water	40 gallons		1 gallon
Arsenate of lead, powdered	1½ lb.	3	teaspoonfuls (heaping)
Lime-sulphur, powdered	5 lb.	4	teaspoonfuls

This is used to combat chewing insects, and certain diseases.

Nicotine Sulphate Spray

Water	40 gallons		1 gallon
Nicotine sulphate, 40 per cent.	½ pint	1¼	teaspoonfuls
Soap, any kind	⅔ lb. 2-3 A	1	ounce

The soap is included as a spreader to reduce surface tension, and to increase coverage of the spray so that it will not be readily removed by rain. This is a contact poison spray for use against aphids, red spider mites, and other sucking insects.

Bordeaux Mixture Spray

This should be used as directed on the package in which the prepared bordeaux mixture is supplied by the manufacturer. It is used to prevent such diseases as scab, mildew and leaf spot.

Among the newer spray materials are DDT for use against chewing insects; mineral oils (summer and dormant types) for scab, and sucking insects; parathion for mites and curculio; chlordane for curculio and grasshoppers; fermate and wettable sulphur for mildews and other fungous diseases.

Trouble from insect pests and diseases can usually be avoided by: (1) planting resistant varieties, (2) maintaining the plantation in a vigorous growing condition, and (3) by practising sanitary methods.

All injured wood, prunings and fallen fruit should be removed and burned promptly, and refuse heaps and debris likely to harbor harmful organisms through the winter season should be cleaned up. Finally, birds should be encouraged to frequent the plantation by building nesting places for them and supplying them with watering and bathing facilities.

Insects

Spraying is required on the prairies more for insects than for disease. Fortunately, the long cold winters of the region preclude many insects that are most troublesome in milder climates. The most common are mentioned below.

Spring Cankerworm.—The wingless female grey moth emerges from the ground in April, crawls up the tree, mates, and lays egg masses under loose scales of bark. The caterpillars hatch when the apple leaves are partly grown and they feed heavily thereon, leaving only the skeletons of the leaves. After three or four weeks they spin to the ground on silken threads or crawl down. They excavate a hole two to four inches deep, enter and pupate. These insects may be easily poisoned with arsenate of lead. An alternate treatment is DDT, at the rate of 1 pound of 50 per cent wettable DDT powder in 50 imperial gallons of water.

Full Cankerworms differ from spring cankerworms by wintering as eggs on the twigs instead of as pupae in the ground. The moths emerge in the fall and lay eggs on the bark in groups one-layer thick. These hatch the following spring into brownish-green caterpillars. Arsenate of lead spray gives control. DDT, as above, is effective and is easily prepared and applied.

Aphids or Plant Lice are found living as parasites on many kinds of plants. In some years they are exceedingly numerous and weaken the plants seriously. They spend the winter as eggs which are laid on the ends of the branches. Although the last family of the year passes from the mother in egg form, earlier increase during spring and summer are born alive. The small greenish soft-bodied insects drill holes in leaves and other soft tissues and suck out the plant juices. Besides the damage done directly to the plant, they also spread disease organisms. They may be controlled with Spray 3.

Spider Mites are not true spiders for the young have only six legs instead of eight. In spring the adults quit their winter quarters in the soil and trash, and crawl up the tree and onto the leaves. There they feed and lay their eggs. Several generations develop during the summer. Sometimes the wind blows them to other trees and plants. They suck juices from the underside of leaves, devitalizing the plant. Because the little creatures spin webs, it may be difficult to spray them thoroughly. Lime-sulphur is effective. Fumes of that poison penetrate the webbing.

Borers are of two or more types. They infest plums, cherries, apples, saskatoons, mountainash, and hawthorns. Some types of beetles, after emerging in June, bite a hole in the bark near the ground and deposit eggs therein. The young eat their way into the tree where they live for three years. Their tunnelling may girdle the trunk and cause its death. Other borer beetles lay their eggs on the bark low on the trunk, often at the edge of cracks or

pruning wounds. The presence of borers is evidenced by fine sawdust-like castings that are pushed out of the holes they make. Where the openings of the borers' tunnels are close to the ground surface, a treatment recommended for trees five years or older is: About one ounce of peradichlorobenzine crystals may be spread around the trunk of the tree about two inches from the bark, and a mound of earth sloped up against the trunk to a height of four or five inches. The fumes, directed by the soil into the tunnels, are toxic to the insects and so effect a kill.

For borers infesting the higher trunk and main branches, the recommended treatment is to apply a paste or thick paint of powdered calcium cyanide and raw linseed oil to those portions of the tree showing insect castings. The proportion of calcium cyanide and oil vary with the temperature. At 70°F., $2\frac{3}{4}$ ounces of cyanide are mixed in one ounce of raw linseed oil. Since calcium cyanide is a deadly poison, the mixture should be made in the open air and extreme care taken to avoid inhaling the fumes. It should be prepared fresh each day and kept covered when not in use. Application should be made with a paint brush. Exposed cambium tissue should not be painted as injury may result.

Curculio, usually referred to as plum curculio, is a common insect on plums although it attacks such other fruits as apples and pears. The insect winters as a dark brown snout beetle about $\frac{1}{4}$ inch long. It has greyish patches on its back and four humps on its wing covers. The adult beetle quits its winter quarters about the time the plums commence blooming. The female, after mating, cuts a hole in the young fruit, turns around and deposits an egg in the wound. It then cuts a crescent-shaped slit beneath the egg. The infested fruit may soon drop. In about a week the egg hatches to a white, legless grub. The larva feeds in the fruit for two or three weeks, then enters the soil to pupate. In about a month it emerges as an adult beetle. It feeds on the developing fruit until autumn when it goes into hibernation. All fruits that fall prematurely should be picked up and burned, and the trees should be sprayed with arsenate of lead at shuck-fall and ten days later.

Weevils are snout beetles that do much injury to filberts and to the seed of sand cherries. The female beetle drills a hole in the young fruit, lays an egg at the opening, and pushes the egg to the bottom of the hole with her snout. The snout beetles may be jarred onto sheets in early mornings of late June and early July and destroyed before egg-laying has begun, or they may be poisoned with arsenicals while fruits are yet too small for beetles to lay eggs in them. Since adults feed on foliage they may be destroyed by poison sprays. It is important that infested filberts be gathered and burned when they drop prematurely in late August and early September.

Tent Caterpillar.—The adult is a brown moth which lays eggs in a mass encircling a twig. The eggs hatch in May and the caterpillars move to crotches of the tree where they build a silken house. During the daytime the worms forage over the tree but return to their tent for the night. The tent may be removed at this time when all the caterpillars will be caught. Arsenate of lead sprays provide effective control.

Fall Webworm differs from the last in that the caterpillars from white moths appear in July, spin their webs on the ends of branches, and live day and night within their webs. When they eat up the leaves and fruit within the web, the webworms enlarge their tents. They winter as pupae under boards or rubbish. The moths emerge in late spring and lay their eggs on the tree. The method of control is the same as that for the tent caterpillar.

Gall Mites are common on the leaves of some stone fruits such as plums, cherry-plums, and cherries. The mites overwinter on the trees under the bud scales in the mature as well as the immature state. As soon as the buds open in spring they become active and attack the leaves. They lay their eggs on the surface of the leaf. As the young mite emerges its feeding causes the formation of a gall which is a narrow upright growth, sometimes as much as ¼ inch in length. The mites forsake the leaves at time of leaf fall, and make their way to winter buds. They may be controlled by applying lime-sulphur, Spray No. 1, at leaf fall or in early spring before leaves appear. Gall mite injury is unsightly but seldom serious.

Scurfy Scale. These are greyish-white scales about ⅛ inch long found on the bark of apple and pear trees. The males make their waxy protective cover of smaller size. These insects overwinter as reddish purple eggs under the female scales, and hatch in late May. Lime-sulphur gives satisfactory control.

Helpful insects in addition to bees, some flies, wasps, and moths, all of which contribute to pollination, include: ladybird beetles, which eat aphids and scale insects; lacewing flies, which live on aphids, mites, and other insects; syrphid flies, the larvae of which eat aphids; chalcid wasps, which drill holes in scale insects and place their eggs therein; and ichneuman flies, which drill eggs into the bodies of caterpillars.

Winter birds that devour insects or their eggs are woodpeckers, nuthatches, and chickadees. It is profitable to supply them with sheltered homes by planting spruce trees, and to attract them by fastening suet in trees.

Diseases

Diseases are in a considerable measure dependent upon weather conditions. Generally, moist conditions are conducive to the growth and spread of disease while dry weather favors insects.

Fireblight, a bacterial malady, is the most devastating disease affecting apple and pear trees in prairie gardens. Kindred fruits, including saskatoons, cotoneasters, and mountainash also may be injured. Stone fruits, when infected, usually have but minor attacks. The organism attacks blossoms, fruit spurs, terminal shoots (particularly if they are growing vigorously), twigs, and sometimes larger branches.

The name is descriptive. The blighted tree appears to have been scorched. The leaves discolor from the base upwards, turning dark brown on apples and black on pears. Although dry, wrinkled and dark, the leaves continue to cling to the branches into winter. Infected blossoms assume a water-soaked appearance and may exude greyish drops that later turn brown. Terminal shoots and twigs tend to discolor and the bark to collapse. Cankers may form at the base of the shoots. Such areas are most important as it is in cankers on wood two years old or more that bacteria over-winter to renew infection the next year.

There is a wide difference in suceptibility among varieties. Florence crabapple may have the blossoms heavily infected but the disease does not progress. Transcendent, if diseased, is likely to suffer tremendously, and to die in a few weeks. The most important preventive is the choice of varieties that are rather resistant to fireblight. The remedy is to cut out diseased wood as soon at it appears. The blossoms should not be cut off. Drastic surgery is the control. The infected wood and healthy tissues about six inches below the discolored wood should be removed. This prevents the downward progress of the bacteria.

Prevention: Very susceptible varieties should be omitted. As the disease thrives on succulent growth, planting should be on soil of only moderate fertility; and over-stimulus of growth by excessive cultivation should be avoided. Aphids, tarnished plant bugs and other insects that spread the organism should be controlled by spraying. All hold-over cankers should be removed before mid-May, and a germicidal covering such as orange shellac or mercuric chloride should be applied to the wounds at the rate of 1 part to 500 parts of water. All new infections should be removed promptly, and the pruning knife sterilized after each cut.

Under southern Manitoba growing conditions, reaction ratings of some apple and pear varieties to fireblight are at present:—

Very susceptible.—Transcendent, Gipsy Girl, Mecca, Prince, Virginia, Charles, Wapella, Hyslop, Yellow Transparent, Tetofsky, Calros, Battleford.

Susceptible.—Alberta, Whitney, Erickson, Ostrakoff, Scugog, Olga, Osman, Geneva, Antonovka, Pine Grove Red, Beacon, Cortland, Wealthy, Waukon, Atlas, Adam, Stevenson, Spangelo, Mantet, Melvin, Linton, Oriole, Prairie Spy, Rosilda, Silvia, Printosh, Blushed Calville, Anaros, Melba, Mortof, Red Silver, and the pears, Miney, and Tait-Dropmore.

Resistant.—Columbia, Dauphin, Moscow Pear, Dolgo, Manitoba, Manitoba Spy, Robin, Breakey, Duchess, Haralson, Ostem, Redant, Almey, Sundog, Joyce, Garnet, Petrel, Godfrey, Jethro, Morden Russet, Hopa, Horace, Herald, Magnus, Moris, Manred, Mount, Heyer 12, Rescue, Patten.

Very resistant.—Florence, Bedford, Trail, Beauty, Manchurian, Green Sweet, Flame, Alexis, and the pears, Ussurian, Harbin, and Liaoyang.

The varieties in the category "very susceptible" are real hazards to the health of the orchard. They should not be planted.

Apple Scab is a fungous disease that thrives in moist weather. It shows on leaves and fruits as dark green velvety spots that later become dark brown to black scabs. Scab slows growth and disfigures the fruits. It may be controlled by burning the orchard leaves in autumn, and spraying with lime sulphur, bordeaux mixture or fermate in spring and early summer. Here again resistance to the disease differs with the varieties. Ordinarily, injury from scab is small in this dry air territory. As more apple trees are planted, the pest may increase and require a regular spraying schedule.

Apple Cedar Rust is caused by a fungus that must pass part of its development on an alternate host, red cedar or juniper. In prairie gardens very little trouble has been encountered from this disease except where junipers and hawthorns are planted near one another. Hawthorns and susceptible varieties of apple trees may be protected by eliminating all red cedar and Rocky Mountain junipers within a quarter of a mile. Injury may be decreased by destroying the roundish, roughened galls on the cedars in early spring and by planting resistant varieties of fruits. It may be controlled by thorough spraying with a form of wettable sulphur. Wealthy is susceptible; Duchess is resistant.

Diseases of Stone Fruits

Stone fruits are prone to injury from a number of diseases. Most common are brown rot, plum pocket, shot hole or leaf spot, black knot, mildew, and silver leaf. As with all diseased trees, the infected parts that are pruned off should be removed promptly and burned. Likewise, infested leaves should be burned in the autumn. Mummy fruits should all be gathered and thrown in the fire. They are dangerous as a source of re-infection next year. Branches killed by disease should be cut back to fresh white wood.

Brown Rot is destructive to most of the stone fruits but to cherries and plums particularly. The organism may attack any part of the tree but it is most apparent on the fruits. When the fungus enters the fruit a brown spot forms. This enlarges and it may cover the whole surface. Such infested fruit first becomes soft and watery then later changes to a wrinkled "mummy". Little tufts, which are the spore-bearing bodies, develop and give a grey powdery appearance. The disease develops rapidly during warm rainy weather. Lime-sulphur sprays are effective. Thinning of fruits to prevent their touching each other is also helpful.

Plum Pocket destroys a large proportion of the crop of native plums in some seasons when the springtime weather is cool and wet. Spores winter on the twigs and buds and are spread by winds in the spring. A week or two after the petals fall the disease is evidenced by small whitish spots on the young fruits. These enlarge with a spongy texture; the fruits swell up; seed development is prevented, and the resulting bladder-like hollow mass becomes covered with grey powdery spores. By early July the disease has run its course and the fruits drop to the ground. A thorough dormant spray with lime-sulphur just before the buds open may give good control. A second spray at summer strength may be given as a precautionary measure when the petals fall.

Black Knot attacks cherries and plums. Large raised roughened areas develop on twigs and branches early in the season. Darkened green, soft and velvety in the early stages, they later become black, hard, and brittle. Control measures involve (1) pruning out all knots, (2) eliminating nearby thickets of wild cherries and plums and (3) annual spraying with lime-sulphur or other fungicides to kill the spores.

Shot Hole or *Leaf Spot* is common on leaves of cherries and plums. Affected leaves show blue areas in early summer. Soon the spots turn red or brown and later the tissue falls out leaving holes. Diseased leaves carry the organisms over the winter. In spring the wind spreads the spores which develop on the young foliage. Lime-sulphur sprays (1) in late April, (2) immediately after petal fall, and (3) 10 to 14 days later, usually give effective control.

Mildew develops on leaves of some strains of sand cherries. Spraying with lime-sulphur, bordeaux mixture, or wettable sulphur is effective.

Silverleaf is a disease of apple, as well as of plum trees. Presence of the trouble is revealed by a leaden grey sheen on the leaves. Usually only one branch is affected for some time, but the infection spreads and may kill the tree. To control silverleaf, diseased branches should be cut out as is done with fireblight on apples. Trees heavily infested should be dug out, removed and burned. Sometimes a branch may have silverleaf and yet the tree may recover. However, it is a dangerous disease and prompt attention to treatment is wise.

Rodents

Some thriving young orchards have met calamity in a few hours by invasion of rabbits or mice but growers can guard against damage. Means of control are (1) exclusion, (2) shooting, (3) trapping, (4) poison baits, (5) repellents and (6) encouragement of natural enemies.

Rabbits: Three kinds of rabbits frequent the prairies—the jack rabbit or prairie hare, bush rabbit or snowshoe rabbit or the varying hare, and the Nebraska cottontail. Of these, only the last is a true rabbit.

The simplest, surest method of control is to exclude all rabbits by erecting a fence of 2-inch mesh poultry netting about the plantation. Usually the height is 48 inches. If snowdrifts pile up, scantlings may be nailed to fence posts and auxiliary strips of fencing nailed to these in the area of the drift. The individual trees may be enclosed in a cylinder of poultry wire or of laths two inches apart nailed to wires. This method of caring for each tree is more laborious and less sure. Any rabbit that gets into the enclosure through carelessly opened gates should be shot.

Wrapping the tree trunk with wire screen, burlap strips, or white building paper is effective. The wraps should be removed about the first of May.

Trapping is practical. Gopher traps placed close to a fence or post upon which is hung a little sheaf of oats or leafy alfalfa at a height of about 18 inches take many rabbits. Cottontails like to get into culverts and piles of brush. Traps placed among tempting food such as apples and carrots under an inverted box with open ends should succeed. It helps to throw some brush or hay over the box. Box traps of various types are being used more and more for cottontails. Those for jack rabbits are larger.

Poisoning may be accompanied by dangers, and is not so necessary for rabbits as for mice.

Repellents that are effective, and at the same time not harmful to the tree, are few. Greases and oils tend to clog the pores of the bark and so kill the cells. A resin-alcohol paint is in favor. It may be made as follows: Heat one pound of cheap resin over a slow fire to the melting point; warm one pint of denatured alcohol in a pan of hot water; add to the resin and stir to an even consistency; bottle and cork until needed. The mixture should be sprayed or painted on the dry bark to a height of about 4 feet. One autumn application should do for the season.

Natural enemies include dogs, owls, and hawks.

Mice: Meadow mice are very common. These prolific little animals live on the surface and in burrows. Their homes are in grass, weeds, and haystacks. Damage to fruit trees is mostly to the bark on the trunks but it may also include the roots.

Tree guards made of various materials give the surest protection. Hardware cloth of $\frac{1}{4}$-inch mesh galvanized metal, or $\frac{1}{3}$-inch mesh galvanized wire, will last a number of years. It may be curved into a cylinder about the trunk; the overlapping edges wired, and the cylinder pushed into the ground two or three inches. Board veneer is a satisfactory guard. The cheapest in material cost is white sulphite building paper. This repellent paper should be wrapped about the trunk and fastened with three ties of binder-twine. Just before freeze-up, the earth should be mounded up the base about three inches to prevent mice from working underneath. Burlap is unsuitable because it is not repulsive and may even be employed in nest-building. Aluminum foil is the latest wrap to win favor. It is effective against sunscald and rabbits as well as mice. It may be purchased in rolls from which strips long enough to overlap about the trunk and low branches may be cut. The wrap should then be pressed in to fit snugly.

Clean cultivation discourages mice. Replacing the upper two inches of soil around the base of the tree with sharp weathered cinders restrains invasion. Runways from the grassy headlands should be closed off by tramping early snowfall down firmly.

Trapping in autumn before heavy snowfall is practical. Spring-back traps should be baited with cheese, peanut butter, rolled oats, or carrot, and placed with the trigger of the trap crossways in runways, or under inverted boxes with entrance holes. Traps should be visited frequently for the mice are active day and night.

Poisoning can be practised when the enemies are numerous and the acreage is large. Oats, chop, alfalfa, and apple or carrot cubes may be treated with gophercide, strychnine, or zinc phosphide. The poisoned bait should be placed in a tin can with the top bent in just far enough to let a mouse enter. The baited can may be set on its side, or in board harbors, or on boards under small boxes.

Natural enemies include dogs, cats, owls, hawks, and weasels.

Pocket Gophers: Pocket gophers may damage roots and sometimes girdle tree bark. They are easily controlled for they advance their tunnels slowly. Early in the spring is the best time to trap them. A hole should be shovelled down to the main tunnel run, usually 6 to 12 inches deep; a trap baited with carrot or apple set and fastened by a chain to a stake, and a shingle placed as a roof over the trap and covered with earth. In poisoning, ½-inch pieces of root vegetables, potatoes, or fruits may be dusted with the poison and placed in the main runways. The entrance used in setting the baits should be roofed over and covered to exclude all light.

Birds

Birds are the orchardists' friends. However, some do damage by eating or merely piercing juicy fruits, particularly cherries and cherry-plums. The most common offenders are cedar waxwings, robins, and catbirds. The trees may be covered with tobacco cloth for full protection. It is good practice to plant a few trees of Russian mulberries near cherry trees. The birds are fond of these berries and feed upon them for a full six weeks' period. Placing water pans in the orchard often helps for frequently the birds are only seeking a drink. Sapsuckers injure fruit trees by riddling the trunk bark with numerous neat oblong holes. These birds, resembling small woodpeckers, usually arrive in late May. If it is impossible to scare them away, the orchardist should discuss his problem with the provincial wildlife authorities. Bark damage should be painted over promptly with a clear asphalt paint such as Braco. This is preferable to grafting wax.

Kinds of Fruits

The home-maker, having decided to develop an orchard, planned the size he wishes to tend, and chosen the favorable location, has one more decision to make. He is confronted with the task of selecting the types of fruits he wishes, and also the varieties in each class. Choice will be determined by what is wanted to eat out-of-hand, to cook, sell, and give to his friends. Selection will be necessarily limited to varieties adapted to his geographic locality. The tree must possess winter hardiness, ripen before autumn cold arrives, and resist prevalent pests such as fireblight in apples and pears and brown rot in plums and cherries. Moreover, he requires an association of varieties that will effectively cross-pollinate one another. For his main planting, reliable guidance as to suitable varieties may be found in the Approved Fruit Lists of Provincial Horticultural Societies.

As to where to buy his young trees—fullest satisfaction may be expected from those nurserymen of the prairies who are well established and have won a reputation for supplying stock that is sturdy, healthy, approved on the Provincial Fruit List, true-to-name, well packed, and shipped promptly.

Apples

Mankind, ever since he began caring for crop plants, appears to have accorded highest rating to the apple. The Canadian prairies have no apples native to the area. Close relatives are the saskatoon, hawthorn and moun-

tainash. The nearest native apple is the prairie crab, *Malus ioensis,* which had its northern range a short distance south of St. Paul, Minnesota. None of its selections, or hybrids, have as yet assumed prominence in commercial fruit growing.

Standard apples, *Malus pumila,* originated in Europe and Western Asia. The apple has been cultivated from remote times—for thousands of years in India and Northern China. Mention of it is found in the earliest agricultural records of England, France and Germany. Through the centuries it has undergone vast improvement by selection and hybridization. As its original home had a moderate climate, most of the leading commercial varieties of standard apples are too tender for the northern prairies. It is necessary to develop strains that are winter hardy, and the logical place for the work to be done is on the prairies.

FIG. 15. Heyer No. 12 apples growing at the Substation, Fort Vermilion, by the Peace River in Northern Alberta, 1949. This widely adapted hardy variety was developed by A. Heyer, Neville, Sask.

Crabapples.—The true crabapple is the Siberian crabapple, *Malus baccata.* It loses its calyx as the fruit ripens. The calyx persists on the common apple. Early writing referred to crabapples as those that 'nippeth and biteth like a crab'. Evidently a keen bitterish acid flavor marked the class. The practical

fruitgrower now distinguishes apples and crabapples mainly by size. The division line is two inches in diameter. Not only does one class blend into the other in size, but shape, stem, flesh and flavor characteristics usually attributed to apples and to crabapples are noted on either side of the 2-inch diameter measure.

Most commercial varieties of crabapples have arisen as hybrids between *Malus pumila* and *Malus baccata*. They are used mainly for making jellies, preserves and ciders. Fortunately there are already a score of useful varieties adapted over a wide range of territory. The Saunders hybrids blazed the apple trail across the northern prairies.

Applecrabs.—This term is ascribed to a class that is midway between crabapples and apples. Examples are Rescue (from the Experimental Station, Scott, Sask.), and the Ottawa varieties, Trail, Rosilda, Piotosh, and Redman. They are generally used for culinary purposes other than jelly-making. As a canned product they are excellent. Some are relished for eating out-of-hand. Trail and Rescue are good dessert fruits.

Rosybloom Crabapples carry blood of the Redvein crabapple, *Malus niedzwetzkyana,* from the mountains of Southwest China. This class is esteemed for its colorful reddish blossoms and showy fruits most of which are small. Some are valued for their fruits which make excellent colored sauces. Scugog and Geneva are examples. Unfortunately, these two are subject to fireblight at Morden.

Dwarf Apples.—In some milder areas apples are worked on roots which limit the growth of the tree and hasten fruiting. The Malling, Paradise, and Doucin stocks used to produce dwarf apple trees have proved tender at Morden. Some strains of Siberian crabapple are slow growing and have a dwarfing effect on the tree grafted on their roots. The fact is that commonly the aim in prairie orchards is to attain a growthy tree rather than strive for a small one. Cold and drought tend to limit apple tree stature. Stocks featured by vigor are needed rather than roots that dwarf.

Pears

Manchurian pears, such as the Ussurian, *Pyrus ussuriensis,* carry abundant hardiness. The fruits are mostly small and gritty but make pleasing jelly. Improvement has been wrought into hardy pears at the Central Experimental Farm, Ottawa, Ont.; the Minnesota Fruit Breeding Farm; South Dakota State College; by David Tait, Carterton, Ont.; and at the Experimental Station, Morden.

At present the largest hardy pears are from the Far East, but the dependable eating pears such as Bantam, and Golden Spice (Minnesota 4), originated at Excelsior, Minnesota.

European pears are tender and prone to fireblight in local gardens.

Plums

Two native species grow in Manitoba. They are the American, *Prunus americana,* and the Canada, *P. nigra.* The sand cherry, *P. besseyi,* is essentially a low-growing plum rather than a cherry, and may be considered the third species of native plums. It extends far northward on sandy soils.

Much improvement has been made in native plums by selection and even more by hybridization. Provincial Fruit Lists emphasize the natives because of their hardiness, earliness, and productivity.

The American $\times$ Japanese hybrid class is large. Tecumseh, Waneta, Underwood, Radisson, La Crescent, Emerald, Red Glow, Redwing, Redcoat and Ember are well-known examples.

Canada×Japanese hybrids are represented by Grenville, Pembina, Ojibwa, and Mina.

The American×Apricot Plum, *P. simoni,* class of fragrant, firm-fleshed plums includes Kaga, Hanska, Tokata, Fiebing and Superior.

European plums, *P. domestica,* are mostly lacking in hardiness. Russian Green Gage usually does well at Morden. It is a pleasing green dessert plum with firm flesh. Among the prune-type purple varieties, Mount Royal, Raynes, and Lunn have done fairly well but are borderline in constitution.

Japanese plums, *P. salicina,* offer considerable promise. Mandarin, introduced by F. L. Skinner, is very hardy. Ivanovka, imported from Manchuria as scions, appears adapted. The rather large, dark fruit is of good quality. A number of yellow and greenish selections are commanding interest. A present need is for good yellow varieties.

Cherry-plums are hybrids of sand cherry and larger plums. Dr. N. E. Hansen of South Dakota pioneered this field. Sapa, Opata and Oka are three of his renowned productions. Manor, Dura, Convoy, Heaver, Mordena and Mansan possess a greater degree of hardiness.

Fig. 16. Sapa bearing well the year after being grafted on a plum tree.

Damsons, *P. insititia,* are mostly rather tender and late in ripening. The purple-skinned, red-fleshed cherry-plums are probably even higher in quality and have proved much better adapted locally.

Sand cherries, *P. besseyi,* or Bessey Cherry, seldom deserve planting. The fruit of this lowly bush has a use in making a cherry vinegar drink. Two terms, "Rocky Mountain Cherries" and "Hansen Bush Cherries", are encountered in western garden papers. The former is usually an ordinary seedling of the wild species. The latter covers seedlings from selections made by Dr. N. E. Hansen at the South Dakota State College over a period of years. Both groups are seedling sand cherries. The hybrid offspring of this species, known as cherry-plums, are much more valuable, being larger, sweeter, and superior in flavor and cooking qualities.

Cherries

There are a number of different classes of cherries deserving planting in prairie gardens. No true sweet cherry has been yet found with enough hardiness. Some of the sweeter cherry-plums make fair substitutes as a fruit to eat out-of-hand or for canning.

Sour cherries of the *Amarelles group*, with light colored flesh, succeed fairly well in very favorable situations. Early Richmond, Montmorency and Dyehouse are leading varieties.

Sour cherries of the *Morello* group have dark colored flesh and are hardier than the Amarelles. Wragg or English Morello is a standard of quality and usually bears well at Morden. Coronation is more robust in constitution. Homer and Moscow merit trial.

Mongolian cherry or dwarf bush cherry, *Prunus fruticosa,* is a small bush of the Morello type. This species from the North Orient is the surest cropper of all orchard fruits at Morden. It has never failed to fruit heavily. Bushes grow three to five feet high. The widely diverse fruits make jelly of the finest quality. Some selections are relatively mild in flavor.

Nanking or Manchu cherries. *P. tomentosa,* are esteemed as fresh fruit, and for canning, juicing, and the making of pies and jelly. The bushes are ornamental. Fruits may range in color from amber white to deep red. A notably hardy strain from Manchuria is known as Northern Limit. Two selections have been named Drilea and Orient (formerly Minnesota 63).

FIG. 17. Drilea cherry, *Prunus tomentosa,* a hardy local variety of Nanking or Manchu cherry that has been relatively tolerant of semi-dry conditions.

Chinese bush cherries, or Korean cherries, *P. japonica,* have undergone improvement in Minnesota. They have been less successful here than the Nanking class.

Apricots

Apricots of acceptable quality have done well at Morden, Brooks, Alberta, and have borne fairly well at Beaverlodge in the Peace River Valley. The Siberian apricot, *Prunus sibirica,* is a small ornamental tree. Its fruits are woody and of interest to the fruit grower as a source of seed to grow root stocks. The Manchurian, *P. mandshurica,* may be useful for cooking but the varieties planted for their fruits are mostly hybrids between the Manchurian and commercial varieties. Scout, Robust, Sing, Tola and Ninguta have become popular. Superior strains of hybrid origin are undergoing further proving.

Shortcomings of apricots are their early blossoming habit and the inclination of the flower buds to develop in warm spells of winter weather. Experience indicates their adaptability to southern Manitoba. A requisite is that they be planted only on very well-drained soil. The roots smother if they are under water for a short time or if growing in heavy wet soil.

Apricots are remarkable for their ability to withstand dry conditions.

Peaches

Peaches are considered out-of-bounds. Even the supposedly hardiest species, David peach, *Prunus davidiana,* kills back badly in trying seasons. Trees blossom very early and the stigmas are sensitive to cold. Although some hybrid peaches have been harvested at Morden, there is little present hope for the successful culture of this fruit crop. For novelty a few plants may be grown as cordons trained close to the ground and covered during the winter.

Native Fruits for the Orchard

A number of tree fruits growing in the woods may be adapted and grown in the tree fruit garden. In most cases fruit size will be larger under cultivated conditions than when the plants had to compete with other bushes and herbs in wildwood thickets.

Saskatoon, *Amelanchier alnifolia,* is sometimes given other common names including Saskatoon serviceberry, serviceberry, Juneberry, shadblow and shadbush. The purple, red or white berries may be eaten out-of-hand, used in pies or cooked in various ways, often in combination with acid fruits such as rhubarb. Saskatoon fruit is the most widely harvested wild fruit in many parts of the prairies. It is enjoyed by birds. A few plants set in the fruit plantation may distract robins, catbirds, and cedar waxwings from feasting on the strawberry and cherry crops. Special care is required in transplanting. Young plants from the woodlands, moved in April, should be cut back level or almost level with the ground. Otherwise the roots may not re-establish. Considerable improvement has been made in native Saskatoons at the Experimental Station, Beaverlodge, Alta.

Bartram serviceberry, *A. bartramiana,* is a smaller bush with fewer but larger and sweeter berries. It makes a handsome ornamental bush.

Pembina, *Viburnum trilobum,* is known also as America cranberrybush, and highbush cranberry. Redmen gave it a two-worded name meaning summer-berry as the bright red fruits in winter brought a reminder of summer. White men contracted the Indian name to pembina. This bush, which revels

in moist conditions, is ornamental at all seasons. Its fruits are gathered by the ton and used in making jelly and pies. A native selection bearing bountiful crops of very large berries was named Manito in 1947.

Bushes transplanted from the woods should be dug with a ball of earth around the roots and promptly headed back close to ground level, similar to the method used in transplanting the saskatoon. Nursery-grown stock can be moved successfully with less severe heading-back, but heavy top pruning is favorable to establishment.

Russian mulberry, *Morus alba tatarica,* although imported from Russia, is mentioned here because of its usefulness. Ordinary commercial large-fruited mulberries are tender but the Russian succeeds well. This strain is easy of culture and is drought-tolerant. It forms a small tree with a bushy head. The leaves are small and varied in outline, some being deeply lobed, others undivided. The fruits, about ½-inch in length and dark red to purplish in color, are found in various stages of ripeness for a period of six weeks or more. Mulberries are a favorite food of summer birds. The presence of some mulberries in the fruit plantation is a considerable safeguard for cherry and strawberry crops.

Plant increase is from seed, June layering, or cuttings. Seedlings display considerable variation in tree, leaf and fruit.

American elder, *Sambucus canadensis,* is valued as a late-flowering ornamental shrub and the fruit is made into pies, juice and wine. The native strain from southeastern Manitoba is preferred. Strains from farther south and east may be tender and too late in ripening. The named variety, Adams, has large fruits. The purplish-black berries are borne in large heads.

Plants are increased from suckers, cuttings or seed. Suggested spacing is from 8 to 12 feet.

Choke cherries, *Prunus virginiana,* and the Black choke cherry, *P. virginiana melanocarpa,* are candidates for the outer rows of shelterbelts. They are easily grown from seed or suckers. The fruits are eaten by children and birds, or made into jam or cherry vinegar drinks. The second species is found in the foothill country and is supposed to rate higher in quality than the common choke cherry. Both species may have bushes with amber, yellow, or red fruits while sister plants produce only the normal dark purple or black cherries. The moderate suckering habit entails some extra work. Other objections are susceptibility to black knot and, in some instances, to mildew diseases.

Black cherry, *P. serotina,* is not found in local woods but is native to northern Minnesota. That strain does well in Manitoba. Some selections have large palatable fruits. The narrow peach-like leaves are handsome and the wood is valuable.

Pin cherry, *P. pennsylvanica,* like the choke cherry, is found across the prairies and far into the North. The bright scarlet to red fruits make excellent, spicy jelly. It may be cultivated but the Nanking cherry gives much greater returns for the work and space involved.

Buffaloberries, *Shepherdia argentea,* or silver buffaloberry, is found in sandy hills and ravines. The small red or golden fruits cluster about the twigs and hold on into the depths of winter. The berries are used for flavoring other cooking or for jelly. Their chief values are as small ornamental trees and to supply food to winter birds.

Mountainash, *Sorbus decora,* extends far into the northern evergreen woodlands. The individual scarlet fruits indicate that the tree is closely related to the pear. Some cooks use the fruits for jelly. The trees may be smitten by fireblight or may become infested with scale insects. The European mountainash ripens its fruits later and hence may remain beautifully decorated in winter while the early-ripening natives are stripped by robins, catbirds, and cedar waxwings prior to their migration southward.

Downy hawthorn, *Crataegus mollis,* grows to a height of about 20 feet. It bears bright green leaves and large white flowers. The pear-shaped, edible fruits are sweetish and may be ½-inch across.

Douglas hawthorn, *C. douglasi,* found in the Cypress Hills, bears fairly large edible fruits, which are a lustrous black.

Fleshy hawthorn, *C. succulenta,* is native to eastern Manitoba. Its fruits become mealy but cling well to the bushes and help keep the grouse from dining on apple tree buds during the winter.

Nuts

The home orchard takes on added interest when furnished with a few productive nut trees. Black walnuts, butternuts, and native filberts bear good and useful crops at Brooks, Morden, and at some other places where they have been given a fair trial.

Fig. 18. Black walnut growing productively on the grounds of A. L. Young, Brooks, Alta.

Black walnut, *Juglans nigra,* of the hardy strain from central Minnesota, bears profitable crops at Morden except occasionally when a late frost damages the blossoms. They do well at Brooks. The black walnut enjoys fertile and rather heavy soils. A young transplant should commence to bear by the fifth or sixth year. The rich tasty meat is encased in bony channels. Considerable work is involved in extracting the nut meat unless the whole nut is steeped a few minutes in very hot water. Then the shell may be cracked and the flesh, being rubbery for the time-being, may be pulled out. Full flavor is regained upon drying and cooling.

Walnuts in the uncracked shell should be planted in October. The irregularly ridged nut should be placed in a hole two or three inches deep. Better germination and better growth of the young plant will result if some sand and acid peat moss are placed at the bottom of the hole. Seedlings are best transplanted when not over two feet tall. Walnuts have thick fleshy roots and do not move so easily as plum and apple stock.

Butternut, *J. cinerea,* is a close relative of the black walnut. It is sometimes called white walnut. The tree is smaller, less shapely, and has duller leaves. The oblong nut carries eight ridges, four of which are prominent. Butternut ranges somewhat north and west of the limit of the black walnut. The rich meat is esteemed in baking and in candy making. Successful trees are found at Saskatoon, Portage la Prairie, and many other points.

Manchu walnut, *J. mandshurica,* from Northern Asia is the most rapid-growing nut tree at Morden. It comes into bearing early, and appears to be the hardiest of the three species. The bark is smooth and the leaves are much longer than the natives. The nut meat is usually too bitter for eating.

Ohio buckeye, *Aesculus glabra,* is a very hardy, round-headed tree. It bears large crops of inedible but ornamental nuts. Propagation is the same as for black walnut, that is, the nuts are planted in moist soil in autumn.

American filbert, *Corylus americana,* is a native shrub that may reach a height of nine feet. The irregularly lobed husk tightly encloses the nut. The fruits are borne in clusters of from two to six. To produce a crop of the edible nuts, the bushes need spraying against weevils and also protection from squirrels, blue-jays, and pheasants. The seed should be planted in the autumn.

Beaked filbert, *C. cornuta,* is another native shrub. It differs from the American filbert in that the husk enclosing the nut is a tube instead of two bracts, and the nut shell is usually thinner.

Manchurian filbert, *C. mandshurica,* is a larger-growing shrub from Northern Asia. The husk is tubular with spreading bristles.

European filbert, *C. avellana,* has proved too tender to reach bearing.

Fruit Zones

A study of plant behavior of different varieties within the several classes of fruits reveals that some general areas are more favorable for fruit growing than others. Horticulturists of the three Prairie Provinces have attempted to zone the territory as a guide to gardeners in choosing suitable varieties. The zones are numbered, No. 1 having more congenial climatic conditions for tree fruits than No. 2. As the zone numbers rise, the list of adapted fruit varieties decreases.

Theoretically climate becomes less temperate as travel is northward, eastward, and to higher altitudes. J. W. Smith in his book, Agricultural Meteorology, 1920, McMillan Company, states:

"Bioclimatic law of latitude, longitude and altitude . . . Hopkins has given the above designation to the law that shows the variation in climate and through that the development of plants and insect activities. He states that in temperate North America this variation is at the general average rate of four days to each degree of latitude, each 5 degrees of longitude, and each 400 feet of altitude. The phenological dates are later northward, eastward, and upward in the spring and early summer, and the reverse in the late summer and fall."

The zone map presented here is based on information received from many growers upon the performance of their fruit trees. Further experience may modify the boundary lines of zones a little or to a considerable extent.

Within each zone there may also be small islands of land that are so favored by slope, large bodies of water, or other beneficial factors, that they deserve a better zone rating. However, their charting on a general map is not practical. Restricted division maps are required to outline them clearly.

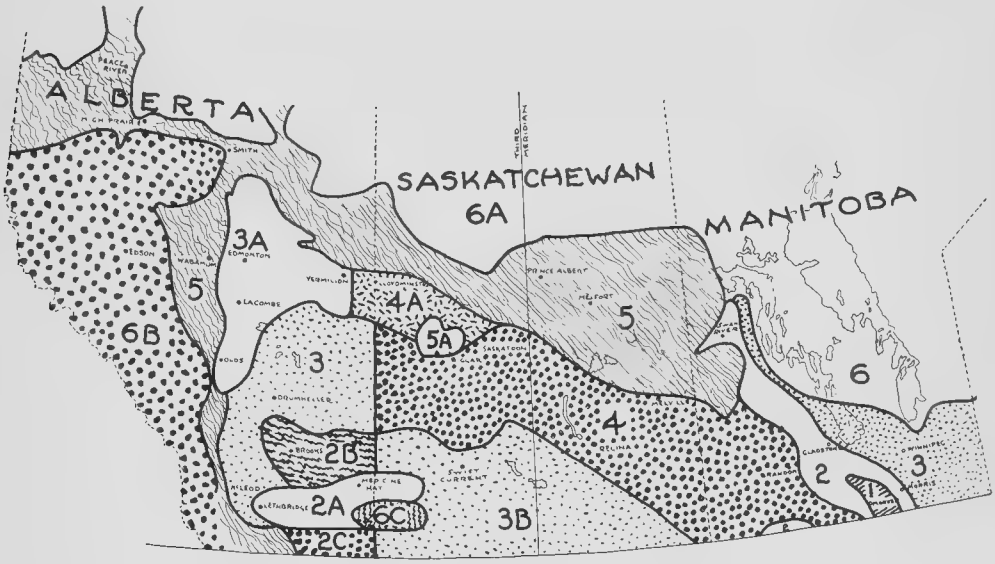

Fig. 19. Fruit zone map.

The Fruit Zone Map covers the three prairie provinces. The task of harmonizing zones across about 800 miles of territory is not yet complete. However, the present map does depict varying conditions and is a reference in choosing tree fruit varieties from the fruit lists recommended by each province. One factor which complicates the co-ordinating of zone lines from east to west across the plains is that of altitude. Most of the ranges of hills extend from south to north. Precipitation is greater towards the east.

Manitoba Zones

Zone 1 involves the Pembina Hills and the contiguous western portion of the Red River Valley. It reaches north to near the Assiniboine river.

Zone 2 surrounds Zone 1 and extends northward along the hills which compose the First Prairie Steppe. At the top of the map the zone turns west to include the congenial Swan River Valley. An outcropping of the zone is noted in southwestern Manitoba as a result of favorable conditions prevailing in the Turtle Mountains.

Zone 3 flanks Zone 2 on the east. It is restricted in some places on the north by high-line soil areas.

Zone 4 is westward.

Zone 6 is in the woodland to the north.

Saskatchewan Zones

Zones 2A to 6A are less tortuous than those in the other two provinces which have terrain more varied with hills or with large bodies of water. The dividing line south to north is the Third Meridian. It runs through Assiniboia and a short distance west of Prince Albert.

The most favorable area for semi-tender tree fruits is marked 2A in the southwest.

Alberta Zones

In this province the complicating influence of chinook winds enters into the situation. These winds tend to promote winter growth on the buds of stone fruits and to disturb to a varying degree the dormancy of other fruits.

Zones are more numerous in Alberta, numbering 8. The most favorable is 2A and the least favorable 6B. The latter is widely extended.

Recommended lists of fruits are developed by the Provincial Horticultural Society of each province. The lists are distributed by the Departments of Agriculture and Experimental Stations.

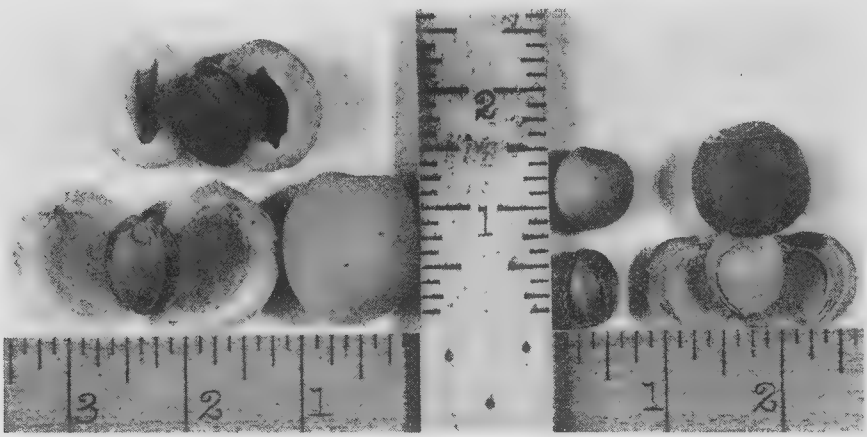

FIG. 20. Fruit improvement in the ascending scale: Right—the woody Siberian apricot; Upper left—Manchurian; Lower Left—the useful Scout apricot, formerly "Morden-600".

Improvement of Fruits

Prairie fruit lists have expanded in a very encouraging and gratifying manner during the last 25 years. A fairly wide range of tree fruits not only succeed but produce fruit of pleasing quality. Nevertheless, the prairie fruit improvement program has only begun. The next quarter of a century should see numerous valuable improvements in apples, pears, plums, cherries, apricots, and other fruits.

The auspicious factors include the increasing numbers of fruit growers; the organization of the Western Canadian Society of Horticulture to promote co-operative effort among technical investigators; recent importations of useful species from the Northern Orient and Continental Europe; the interchange of varieties with Experimental Stations in the north-central prairie states; better

facilities for fruit gardens, particularly in the use of water for irrigation; more enlightened understanding of cultural and pest control problems; and new knowledge on fruit breeding, fruit processing, and fruit storage.

All cultivated fruits are derived from wild species, and a very large number of the cultivated varieties originated as chance seedlings. Now that fruit breeders are making controlled crosses—combining only those parents carrying the desired characteristics—progress is being speeded up.

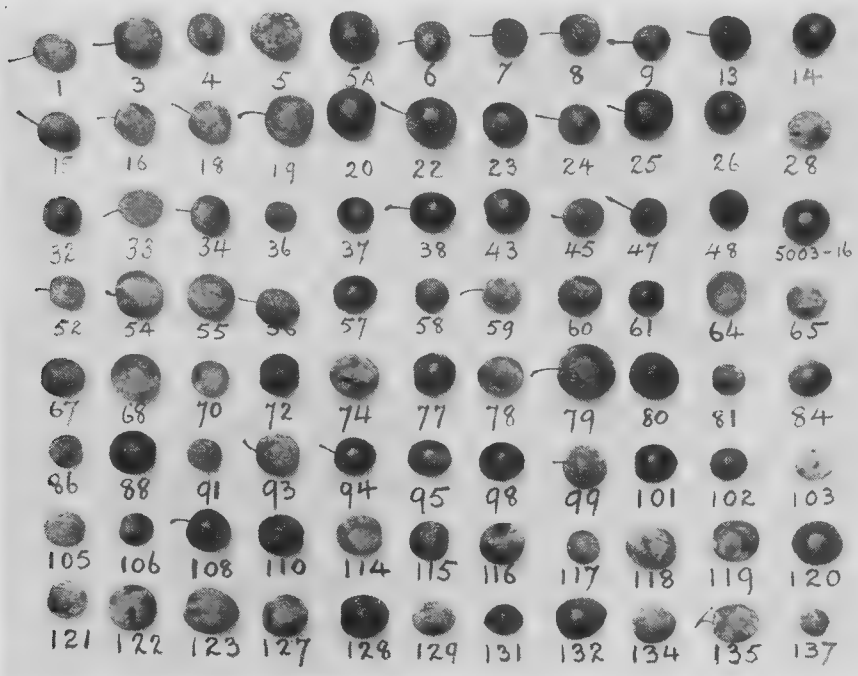

FIG. 21. Sister plums. They had one mother, but since hardy plums require cross-pollination, the pollen parentage is probably varied. One fruit from a number of sister trees is shown. The differences emphasize the variability involved in growing tree fruits from seed. In this case the mother was a native plum, *Prunus nigra*. Had it been a hybrid plum, a greater variation in the fruit of the progeny might have been expected.

A roving missionary, John Chapman, known in story and song as "Johnny Appleseed" did much for the Northern States in planting apple seeds in great quantities. In Prairie Canada, his counterpart was G. F. Chipman of the Country Guide. This public benefactor distributed thousands of apple and plum seedlings from the Red river to the Peace River Valley in addition to sending out hundreds of pounds of seed. Scores of farms and homemakers on the plains have grown tree fruit seedlings. A considerable number of useful new varieties have resulted from these already, and more are being developed.

Fruit Seedlings

Too much is often expected from seedlings. High quality cannot be achieved if the blood lines entering the seedling do not carry the factors for superior quality. Seedlings grown from a named variety will be different

from the parent—usually very different. Nearly all hardy orchard fruits are cross-pollinated which means that they have two separate parents. This is necessary to set seed, and, since practically all plums are self-unfruitful, these require pollen not only from another tree but from a tree of a different variety for seed formation. Thus in the growing of fruit seedlings the results are very uncertain. It is calculated that, in a population of 800, one seedling with fruits superior to the mother parent is a good average achievement. A somewhat higher average is probable when controlled crosses are made between skilfully selected complementary parents. However, hundreds of thousands of seedlings may be raised to develop a few varieties that deserve to replace their parents.

Fruit breeding by hybridization or cross-breeding is not difficult but requires close care, skilled labor, and a long period of time. As the work is expensive in time and money, it is done mostly at those institutions given government support. There is an advantage in having the parent trees grown in pots or buckets in a greenhouse where the environment is controllable.

The several steps are: (1) collect pollen, dry it on glossy paper and place it in a glass phial or metal dish; (2) emasculate the flower (remove the stamens); (3) transfer the chosen pollen to the stigma of the pistil, and record the cross not only on an attached label but also in a note book; (4) place a paper bag over the flower to keep off insects that may be carrying foreign pollen; (5) protect the fruit that has set with a cheesecloth covering; and (6) gather the seed, plant it, and study the progeny for individual performance. It will be 10 or 12 years before some seedlings will fruit. A selection thereafter undergoes a period of retesting, preferably for 10 years, before its worthiness for introduction is decided. There is often a strong temptation to introduce a variety too quickly, that is, before its weaknesses or shortcomings have a chance to show up.

Prairie fruit trees must be hardy, early-ripening, and be able to withstand dry weather in summer and winter. There is a wide opportunity for improving prairie fruits. The more people who follow this fascinating pursuit, the more diverse will be the results and the more rapid should be the progress.

Fruit Exhibits and Judging

Exhibiting fruits at local and provincial fruit shows is good citizenship. It spotlights your garden and district. The exhibits illustrate the productivity of fertile prairie soil. Moreover, their display encourages other residents to indulge in the year-round pleasure of growing an orchard.

There are five points to heed in selecting fruit for the exhibition—condition, uniformity, size, shape, and color. Ideally, condition means firm-ripe, and free from blemishes, including damage from insects and diseases. Uniformity implies that each individual specimen resembles its companions in size, shape, and color. The size, both in length and in diameter, should be that expected for the variety when well grown. Oversize as much as undersize fruits should be excluded. The shape of the stem as well as the over-all outline should be the same for all fruits on the plate, or in the basket or flat. The color is expected to conform to that recognized as typical for the variety whether it be solid color, blushed, or striped.

The exhibitor should study the prize list and adhere to it precisely. The exact number of specimens called for should be placed.

Score Card for Plate Exhibits

Form	15	points
Size	15	"
Color	20	"
Uniformity	20	"
Condition	30	"
	100	

In box or basket exhibits some of the points will be given for general appearance, which includes attractiveness of pack and arrangement of fruits. The judges will disqualify an entry not true to name. Any evidence that the fruit has been attacked by either insects or diseases will lower the rating of an exhibit. Apples and pears should be shown with their stems left on. Fruits that develop a waxy skin covering or bloom should be handled without having it rubbed off.

Calendar

JANUARY. Study nursery catalogues. Inspect plantations for invading rabbits. Attend Farm and Home Week. Check over rootstocks and scions in storage for moisture and well-being. After-ripen stone fruit seed in a storage of about 41°F. Fill feed boxes for winter birds.

FEBRUARY. Order spray materials. Attend the annual Horticultural Convention and Short Course. Contract for tree needs for April planting. Perform root-grafting. Shoot any rabbit that has gained entrance to the orchard enclosure. After-ripen apple seed in 41° F. storage.

MARCH. Watch rabbit fences for breaks and snowdrifts. Keep drains open so that water from early thaws will not accumulate and freeze over the roots of trees.

APRIL. Prune trees. Set out new stock promptly when the soil is fit. Prepare for spraying. Inspect overwintered colonies of bees. Sow after-ripened fruit seed. Plant out root-grafts in the nursery-row. Fertilize old bearing trees. Till orchard as soon as the topsoil is dry. Apply dormant sprays.

MAY. Place bee colonies in the orchard. Complete pruning. Remove paper wraps from tree trunks. Loosen labels wired onto branches. Spray fruit trees according to pests in evidence. Rake down earth mounds from trees treated for borers. Scare off the sapsuckers in late May, but spare the woodpeckers. Photograph blossoming trees.

JUNE. Thin fruits. Apply late spray if required. Layer lower branches of trees chosen for increase. Purchase fruit packages for sale of surplus crop. Use cultivators to eliminate weeds and to stimulate vigorous growth in early season. Furnish watering basins for birds.

JULY. Complete the thinning of fruits. Irrigate, if soil and subsoil need water. Visit Field Day events. Do bud-grafting. Cease tillage by mid-July. If the season is rainy, sow a cover crop of oats and barley to promote early ripening of tree shoots. Support heavily laden branches with comfortable props. Harvest early cherries.

AUGUST. Harvest early fruits. Collect and burn all dropped fruits that carry insects or disease. Irrigate during prolonged dry weather. Join tours of orchardists. Order trees for fall delivery.

SEPTEMBER. At the proper time of maturity harvest plums, apples and pears. At end of the month surround trunks of those trees harboring borers with a "death-ring" of P.D.B. crystals and cover with a cone of earth.

OCTOBER. Harvest late apples. Patch rabbit fence surrounding the orchard. Dig holes for trees to be planted in April. If the soil is dry, irrigate thoroughly in mid-October. Run ditches to carry off surplus snow waters that might otherwise accumulate about the trees in late winter. Sow fruit seed, or stratify and place in storage. Bait mouse runways. Erect auxiliary slat shelters. Clean up refuse.

NOVEMBER. Spread on the ground branches of surplus apple trees to decoy rabbits and mice from orchard trees. Plow early snowfall into ridges to hold drifting snow in the orchard. Place tree trunk guards or wraps to combat mice, sunscald, and rabbits. Cut and store scions. Mound soil up two to three inches on the base of paper wraps at freeze-up time. Provide feed boxes for winter birds. Regulate temperature and humidity in fruit storage cellar.

DECEMBER. Renew subscriptions to horticultural journals. Attend horticultural meetings. Tramp down snowfall at the edge of grassy headlands to block off runways of mice. Paint implements. Repair equipment. Replenish bird feed boxes.

General Comments

Reference books and bulletins have been consulted freely as this treatise took form. The author on behalf of the reader and himself expresses gratitude to those who have provided their fellow fruit growers so generously with helpful literature.

The information given here is general in nature. Readers wishing more complete treatment of the many phases of the subject are directed to recent standard books and to more intensive bulletins dealing with orcharding. The chapter on pests is an example of casual treatment. The attack on fruit insects and on fruit disease problems is changing at an astonishing rate as a result of the co-operative efforts by chemists, entomologists, plant pathologists, and orchardists. The individual grower is urged to request a copy of the current Tree Fruit Spray Calendar from the Provincial Horticulturist each winter so that his plantation may benefit from the latest advances in plant protection. Details on effective sprays, their preparation, and their application may be found in these calendars.

The prospective fruit grower is urged to visit successful growers in his zone. From them he may obtain facts and profit by their experiences. Each Provincial Department of Agriculture publishes annually a Fruit List of Varieties adapted to the several zones. It is wise to restrict the choice of nursery trees largely to those varieties rated as possessing proved adaptability. Although the adventurer will wish to include a few new alluring introductions of which the constitution is in question, at least every alternate tree should be a variety noted for local hardiness and productivity. The only nursery fruit tree worthy of a space in the plantation should be one that is healthy, vigorously developed, and worked on the hardiest rootstock.

Any farm producing profitable crops of bread wheat has the capacity for growing at least a few tree fruits in its well-sheltered garden. Favored areas will enjoy fruitful trees of apricots, apples, plums, cherries, pears, walnuts, and filberts. In colder territories with short growing seasons the home-maker can with confidence plant some crabapples, selected native plums, dwarf bush cherries, choke cherries, pembinas, and saskatoons. Few adjuncts to the prairie home farm provide as many varied and successive pleasures throughout the year as does the tree fruit plantation—the prairie home orchard.

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